



2809394768

No. 149/H

J. 51-

170




THE INSTITUTE  
OF  
OPHTHALMOLOGY  
LONDON

EX LIBRIS

OPHTHALMOLOGY H 460 MACCALLAN [2]

B. 4  $\frac{3}{16}$





Digitized by the Internet Archive  
in 2014

<https://archive.org/details/b21287818>

TRACHOMA  
AND ITS COMPLICATIONS IN EGYPT

CAMBRIDGE UNIVERSITY PRESS

London: FETTER LANE, E.C.

C. F. CLAY, MANAGER



Edinburgh: 100, PRINCES STREET

London: H. K. LEWIS, 136, GOWER STREET, W.C.

Berlin: A. ASHER AND CO.

Leipzig: F. A. BROCKHAUS

New York: G. P. PUTNAM'S SONS

Bombay and Calcutta: MACMILLAN AND CO., LTD.

ALSO PUBLISHED IN ARABIC  
BY THE NATIONAL PRINTING PRESS, CAIRO.

*20*

*All rights reserved*

# TRACHOMA

## AND ITS COMPLICATIONS IN EGYPT

BY

A. F. MACCALLAN

M.D. CAMBRIDGE, F.R.C.S. ENGLAND  
DIRECTOR OF OPHTHALMIC HOSPITALS, EGYPT

“Si enim alicui placet mea devotio, gaudebo. Si autem pro mei abjectione vel pro viciosi sermonis rusticitate nulli placet: memet ipsam tamen juvat quod feci.”

HROSWITHA: quoted in Ekkehard.

Cambridge :  
at the University Press

1913

DEDICATED BY PERMISSION TO  
FIELD MARSHAL THE VISCOUNT KITCHENER  
OF KHARTOUM AND THE VAAL

G.C.B., O.M., G.C.S.I., G.C.M.G., G.C.I.E.

182/893



## PREFACE

THE clinical material on which the present small work is based has been obtained at eight ophthalmic hospitals which have been opened by the Government under my direction since the year 1904. During the course of the present year, 1913, the ophthalmic system will expand to fourteen hospitals, an increase for which all equipment and a trained staff of Egyptian surgeons and attendants are now ready. The administration and clinical direction of these hospitals is vested in the Director with the assistance of two British and one Egyptian Inspecting Surgeons.

Both permanent and travelling hospitals have their place in the Egyptian system of ophthalmic relief. The permanent hospitals which are now being built in the capital town of each of the fourteen provinces into which the country is divided, have accommodation for 14 in-patients. Some of the hospitals however are more commodious, giving accommodation to 20 or 30 in-patients.

The travelling hospitals are a special feature of the system. Each hospital consists of a number of Indian tents including one especially spacious for the performance of operations. Each camping ground is occupied for four to six months. In this way most of the larger towns in Egypt have been visited. Only poor people are received as patients and all treatment is gratuitous. It is due to the popularity of these hospitals that the need for ophthalmic relief after countless generations of suffering and disability is becoming felt by the people of Egypt, a need which was not realised until the establishment in 1904 of the first hospital under the sole surgical charge of the present Director of Ophthalmic Hospitals.

During the year 1912, 341,211 attendances at the various hospitals were made by 28,029 patients and 21,315 operations

were performed. It should be mentioned that all patients attend entirely voluntarily, and that more than 6000 trichiasis cases were turned away because the surgeons had no time to perform the required operations.

A complete description of all the methods of treating trachoma and of all the various operative procedures has not been attempted in the following chapters. A simple description of trachoma as it is met with in the East and of its treatment as carried out at the Egyptian Ophthalmic Hospitals has alone been attempted.

The different methods in which ophthalmic relief may be given have been thoroughly studied and no time has been spared in the consideration of the various suggestions which have been made. Realizing the impossibility of effecting an ophthalmic revolution in any finite period it has been considered all important to put those means of relief which future generations will use and will profit by on a firm and lasting basis. The means which have been decided on are the establishment in each province of a permanent built hospital in the capital town and of a travelling tent hospital to tour round the more distant towns and villages. From each of these centres will develop various branches of work including treatment of the pupils in schools and kuttabs, lectures on ophthalmic hygiene, distribution of pamphlets giving instructions for the prevention of infection, provision of first aid in eye disease in the remoter villages, talks in simple language to collections of women of the necessity of cleanliness for their children and of the way it should be effected. Money, skilled labour and time will gradually work a vast improvement among a people who are intensely anxious to avail themselves of the comparatively small amount of ophthalmic relief which is at present available, but which is being rapidly increased through the powerful and sympathetic influence of Lord Kitchener.

A. F. M. C.

*March 12, 1913.*

# CONTENTS

PART		PAGE
I.	1. History of our knowledge of trachoma . . . . .	1
	2. Prevalence of trachoma in Egypt: climatic and racial variations . . . . .	3
	3. Age and mode of infection by trachoma in Egypt . . . . .	3
	4. Clinical description of the stages of trachoma . . . . .	5
	5. Acute conjunctivitis complicating trachoma . . . . .	11
II.	Pathology of trachoma . . . . .	22
III.	Treatment: 1 of trachoma . . . . .	30
	2 of sequelae of trachoma . . . . .	40
	3 of acute conjunctivitis . . . . .	48
IV.	1. Differential diagnosis . . . . .	55
	2. Prognosis . . . . .	58
	3. Influence of trachoma on ophthalmic operations . . . . .	58
	4. Prophylaxis . . . . .	59
	5. Causes of blindness in Egypt . . . . .	62
	6. Statistics . . . . .	64
	7. Literature . . . . .	69
	Index . . . . .	71



## PART I.

### 1. HISTORY OF OUR KNOWLEDGE OF TRACHOMA.

THE papyrus discovered by the archeologist Ebers, which carries back 3500 years from to-day our knowledge of Egyptian history and of the customs of the ancient Egyptians, indicates that both purulent ophthalmia and trachoma were rife in the country at the period of its inscription.

The famous Greek physician Hippocrates who flourished about the year 422 B.C. was well acquainted with *τρίχωσις* or trichiasis of the eyelids. Celsus a Roman surgeon about 14 A.D. gives a good description of the roughness (*aspritudo*) of the inner membrane of the lids and recommends rubbing and scarification. Cassius Felix equally, about 447 A.D. describes “trachomata id est asperitates palpebrarum.” It has been said that important books by the surgeons of the Ptolemaic and Roman periods were lost in the conflagrations which at different epochs destroyed the famous library of Alexandria. Something has been preserved, however, in a commentary on surgical works in the library, made by the Byzantine Greek author Paulus Aegineta, who lived at Alexandria about 600 to 640 A.D., that is before the Arab invasion. This author gives a chapter *περὶ τραχώματος* in which he distinguishes the fresh cases as *σύκωσις* or fig disease, because the conjunctiva is like the surface of a cut fig, and the chronic cicatricial cases as *τύλωσις* or callosity. He was acquainted with an instrument for scraping the lid called *βλεφαρόξυστον* or lid scraper. He also mentions trichiasis, for the cure of which he describes the operation in common use in Egypt among the fellahin. The operation consists in attempting to evert the ingrowing lashes by the removal of a piece of skin from the upper lid; it is effected by

including a fold of skin between two pieces of reed or stick which are tied tightly together at their extremities. The skin necroses since its blood-supply is cut off, and is detached after some days with the pieces of stick. The entropion is occasionally cured but always at the expense of a shortened upper lid and the frequent production of lagophthalmos.

Many of the Arabic general and ophthalmic surgeons from the ninth century onwards give a description of trachoma as garab جرب or itch of the conjunctiva. They describe trichiasis and pannus and such operations as scraping, scarification, etc.

The most important of the mediaeval manuals of ophthalmology written in Egypt was that of Omar El Mausili غمر الموصلي written about 1000 A.D.

The frequency of eye diseases in Egypt was mentioned for the first time by the Arab oculist El Shadli الشاذلي in the thirteenth century. This was also remarked on by the Rabbi Meshoollam Ibn Menahem in the fifteenth century. The first European medical traveller, Prosper Alpinus, 1683 A.D., mentions the frequency of bleary eyes or lippitudines during the summer in Egypt.

It should be particularly noted that both the Greek and the Arab surgeons distinguished exactly between chronic trachoma and acute ophthalmia.

The prevalence of purulent ophthalmias was particularly brought to the notice of Europeans during the Napoleonic expedition to Egypt (1798–1802). Both French and English troops fell victims. Even as early as 1798 the French were obliged to invalid home a large number of blind, amongst whom were several army surgeons. An account of the ophthalmic results was written by the French surgeon Larrey, which exactly describes the course and sequelae of acute gonococcal ophthalmia. We can also deduce the occurrence of a conjunctivitis perhaps due to Koch-Weeks baccillus, for acute conjunctivitis broke out in the spring of 1801, attacking more than 3000 French soldiers, without a single one losing his sight. This accords with what we know of the period of occurrence and course of Koch-Weeks conjunctivitis. The British troops suffered seriously from gonococcal ophthalmia, and it is noteworthy that it was to relieve soldiers invalided from the



service in this campaign that the Royal London Ophthalmic Hospital, Moorfields, was instituted.

Amongst others who have carried on important work in elucidating the question of eye disease in Egypt the following investigators must be mentioned:

Macgregor, 1812; Píringer, 1841; Pruner, 1847; Koch, 1887; Kartulis, 1887; Hirschberg, 1890; Muller, 1898; Morax, 1902; Lakah, 1902; and at the present day Meyerhof.

## 2. PREVALENCE OF TRACHOMA IN EGYPT: CLIMATIC AND RACIAL VARIATIONS.

Trachoma is generalized throughout Egypt, affecting about 95 per cent. of the population. The inhabitants of Abu Simbel and Feriq are victims to the disease to the same extent as those of Damietta, though nearly 10 degrees of latitude intervene between them, and though the swamps and dampness of the northern town contrast most markedly with the dryness and heat of the southern village. Climatic conditions therefore do not appear to play any decisive part in the incidence of trachoma in Egypt.

The complications of trachoma more severely attack the inhabitants of thickly populated and overcrowded towns and villages than the inhabitants of sparsely populated districts. The neighbourhood of a dusty area such as the ancient site of an uninhabited town is specially productive of a severe degree of trachoma.

None of the races which inhabit Egypt—fellahin, Arabs, Berberines, Sudanese, Europeans—are immune from the disease and all suffer equally when exposed to the same conditions of contagion, filth and overcrowding.

## 3. AGE AND MODE OF INFECTION BY TRACHOMA IN EGYPT.

Children are generally infected during the first two years of life. Until recently we had supposed that the infection of the infantile conjunctiva invariably occurred after birth, from the

diseased conjunctiva of the mother or nurse, by the intermediary of fingers or handkerchiefs. However, recent research seems to show that trachoma of the genital passages of both men and women occurs and that trachoma of the newly born may occur as the result of infection during the process of delivery.

Absence of strict cleanliness is almost universal among the lower classes and facilitates contagion. At no period of life can any one living in Egypt avoid shaking hands with people who have contagious trachoma, in the discharge from which their fingers are often steeped. The constant possibility of contagion is thus easily understood. The need to rub the eyes in Egypt is greater than in most other countries on account of the irritation by dust and flies. In households it is common after ablutions for the same towel to be used for the faces of the whole family. The conjunctival secretion of each one is wiped on it, and there is small chance that any one of the family will long retain a healthy conjunctiva.

Transmission of contagion by flies is probably the least common of the various modes of infection. It cannot be definitely stated not to take place, but there is no scientific evidence of its occurrence, in spite of the efforts which have been made by Morax and by Meyerhof to obtain it.

An attack of acute conjunctivitis frequently precedes infection with trachoma. Hence in former times it was thought that trachoma itself always began acutely. This, however, is rarely the case. The acute symptoms are usually caused by well-known bacterial organisms, of which the most important are the diplobacillus of Morax-Axenfeld, the Koch-Weeks bacillus and the gonococcus.

An acute conjunctivitis is highly contagious on account of the purulent discharge which is spread about by the fingers on clothes and utensils. As the original sufferer in Egypt so frequently has trachoma, this disease may be transmitted along with the acute conjunctivitis.



## 4. CLINICAL DESCRIPTION OF THE STAGES OF TRACHOMA.

The disease trachoma is manifested in many widely differing forms, and it is impossible to obtain a lucid idea of the disease until these forms have been classified and arranged in the sequence of their development.

The classification which I have suggested and which has now been in use at the Egyptian Ophthalmic Hospitals since 1905 is naturally a development of that described by Raehlmann.

I have divided the disease into four stages according to the comparative prominence of the three features, granulations, papillary hypertrophy, and connective tissue formation. Thus the first is trachoma stage I (called trachoma I). The second is trachoma stage II (trachoma II), the third is trachoma stage III (trachoma III), and the fourth is trachoma stage IV (trachoma IV). The second stage has three subdivisions, *a*, *b*, and *c*. The scheme of classification is represented thus:

Trachoma I, seen typically soon after infection has occurred.

Trachoma II*a*, in which follicles predominate.

Trachoma II*b*, in which a papillary hypertrophy coexists with the follicles. This subdivision may be split up into trachoma II*b'* and trachoma II*b''*. Trachoma II*b'* is unmixed trachoma; trachoma II*b''* is trachoma complicated by spring catarrh.

Trachoma II*c*, trachoma complicated by chronic gonococcal conjunctivitis.

Trachoma III, in which cicatrization is beginning.

Trachoma IV, in which cicatrization is complete.

With a comparatively small amount of experience most cases of trachoma can be placed easily in one or other of these stages. Some cases are on the border-line between two stages and may be so indicated, e.g. trachoma I to II*a* or trachoma II*a* to III.

In my experience unmixed trachoma is always a chronic disease. It frequently commences with acute manifestations or exhibits acute exacerbations, but these are the result of super-added infections with well-known bacteria. Trachoma with acute

onset has, however, been thoroughly investigated and described in which no bacteria have been detected. The existence of acute trachoma cannot therefore be denied.

### *TRACHOMA I.*

One finds on the conjunctiva of the tarsus of the upper lid and of the superior cul-de-sac, slight roughnesses, forming grayish islands which are semi-transparent and almost non-vascular. These roughnesses are follicles or granulations. There may or may not be a mucous discharge. It is on the tarsus in Egyptians, and in the cul-de-sac in Europeans that the disease commonly commences.

The conjunctiva of the fornix is usually bluish-white in colour in all stages of trachoma in Egypt, but this is the result of cicatrization after gonococcal ophthalmia, and antedates, in many cases at any rate, the trachomatous process.

Trachoma of the cornea is known as pannus. It is manifested by the extension on to the cornea of blood vessels. These blood vessels are derived from the conjunctival vessels, and introduce themselves between the corneal epithelium and Bowman's membrane. Pannus commences during the stage trachoma I. It is preceded by a superficial infiltration of the corneal epithelium, which is manifested by a slight diffuse haziness. Pannus must be distinguished from two other conditions in which the cornea becomes vascularized, the process of healing of a corneal ulcer, and interstitial keratitis.

(a) The vessels in pannus spring from the network of marginal loops, which can be traced on to the cornea as efferents of the conjunctival vessels—that is, they are superficial.

(b) The healing of the corneal ulcer is carried out by a process of vascularization of the edges of the ulcer by the ingrowth of vessels from the conjunctiva. The vessels are fewer and larger than in pannus and are not seen all round the cornea.

(c) The vessels in interstitial keratitis cannot be traced from the cornea on to the conjunctiva: they come to an end at the corneal margin, being derived from the vessels of the sclera, and therefore deeply situated.

This simple form of trachoma may disappear, leaving only very slight traces of its previous existence in faint whitish lines on the tarsus, the result of the replacement of the cellular contents of the follicles by fibrous tissue. By this transformation trachoma I becomes first trachoma III and later trachoma IV. The period occupied by this process of cicatrization may be from a few weeks to several years.

On the other hand, instead of this favourable change, the follicles may increase in size and number with the production of trachoma IIa; or a papillary hypertrophy may develop, trachoma IIb; or infection with gonococci may occur, trachoma IIc.

### TRACHOMA II.

In trachoma II there is usually a discharge, and on this account the stage is particularly contagious. Trachoma IIa exhibits numerous grayish follicles which protrude above the level of the rest of the conjunctiva. These little tumours easily rupture when manipulated, allowing their gelatinous contents to escape. They are scattered all over the tarsal mucous membrane of both upper and lower lids and are especially prominent at the retro-tarsal fold of the upper lid. The upper conjunctival fornix is generally free from follicles in natives of Egypt, while in Europeans the fornix is their chief seat. In some cases the individual follicles can no longer be distinguished, becoming merged into a general infiltration; the thickened conjunctiva then assumes a gelatinous appearance known as *Stellwag's brawny oedema*. The changes which occur in the process of cure will be described minutely in the pathological section. It suffices to say here that the follicles may disappear and be replaced by fibrous tissue, the stage trachoma III developing. In this stage the tarsus is always thickened by an inflammatory exudate. In some cases this thickening may be considerable, and then the replacement of the small-celled infiltrate in the substance of the tarsus by fibrous tissue, which occurs in the process of cure, causes permanent deformity. This stage may last for years if untreated. Under vigorous daily treatment the change from trachoma IIa to trachoma III may be effected in fifteen days usually.

The bulbar conjunctiva in trachoma IIa is occasionally the seat of masses of trachomatous tissue: this, however, is rare.

Trachoma IIb. Here there is a formation of red raspberry-like papillae or elevations which mask more or less the typical gelatinous follicles. The elevations may become as large as a cock's-comb on the upper lid, where they are always more marked than on the lower lid. Two sub-varieties may be distinguished: trachoma IIb', which is unmixed trachoma, and trachoma IIb'', which is trachoma complicated by spring catarrh. The conjunctival discharge in trachoma IIb'' contains a large number of eosinophile cells.

Many cases of trachoma complicated by spring catarrh are easily distinguished clinically by the form and consistence of the conjunctival elevations, which are flat-topped and hard, like the granite paving stones which used to be used in England. The less typical cases cannot be distinguished from papillary trachoma, trachoma IIb', and are perhaps identical with it. The papillary growths in cases which are usually recognized as trachoma IIb' are soft and shaggy, they may disappear spontaneously, but their treatment by drugs is unsatisfactory.

Though the development of either of the stages trachoma I or trachoma II may have reached a considerable degree, it may be that the external appearance of the eyes presents little or no evidence of disease, and that there are no severe subjective symptoms. It is therefore invariably necessary to evert the lids before venturing any opinion as to the presence or absence of trachoma. The upper lids are usually more severely affected than the lower. They also are much more difficult to cure than the lower lids. The conjunctiva of both eyes is almost always affected in trachoma II. In trachoma I it may be that one eye remains uninfected for a considerable time.

Trachoma IIc, called by Meyerhof *florid trachoma*, is the result of the reaction of the trachomatous conjunctiva to chronic gonococcal inflammation. It is seen typically in infants previously the subjects of trachoma I. It is manifested by a dark red tumefied velvety appearance of the conjunctiva, accompanied by muco-purulent discharge. In many cases the tumefaction of the conjunctiva causes complete retroflexion or ectropion of the upper



lid. The condition if untreated may last for several months; the ectropion is rectified spontaneously when the swelling of the conjunctiva subsides. The cornea is rarely exposed by the retroflexion of the upper lid, but is likely to suffer from the constant proximity of the infected conjunctiva. Under treatment the conjunctival swelling may subside in a few days or a few weeks. No surgical measures should be undertaken for the relief of the ectropion until the discharge has been much reduced and unless much hypertrophy of the conjunctiva has occurred, with consequent stretching and permanent lengthening of the horizontal extent of the eyelid.

### *TRACHOMA III.*

In this stage cicatrization has definitely begun, or is more or less advanced. Islands of inflamed conjunctiva or of trachomatous follicles are seen to be surrounded by a network of fine lines of conjunctival tissue. In this stage necrosis often results from the pressure of the shrinking connective tissue (post-trachomatous degeneration). The necrotic tissue remains as a degeneration cyst or may become calcareous. The cicatrization which is typical of this stage is pathognomonic of trachoma: this is far from stating that all cicatrices of the conjunctiva are caused by trachoma.

Complete immunity to trachoma is only conferred by complete cicatrization of the conjunctiva. Partial cicatrization, however, such as that which results from trachoma I after conversion into trachoma III without the intervention of trachoma II, is certainly protective. Relapses from trachoma III to trachoma IIa are common when treatment is stopped. Fresh infections probably occur, but must always be difficult to distinguish from relapses.

In this stage as well as in trachoma II trichiasis or entropion may occur. A proliferation of the eyelashes results in trichiasis. The inversion of the free border of the lid, the result of changes in the tarsus, results in entropion. In both trichiasis and entropion the lashes rub the eyeball.

### *TRACHOMA IV.*

Trachoma IV is a condition in which there is a smooth conjunctiva seamed by white lines of connective tissue. This

is the stage of practically complete cicatrization of the conjunctiva or of cured trachoma.

I am aware that there are many cases which cannot be stated to belong to a definite stage; for instance, a case may be between trachoma II and trachoma III, or between trachoma III and trachoma IV. But this division of the disease into stages has been found to be valuable for the purpose both of teaching and of treatment.

Pannus is always marked in trachoma II and III. In severe cases pannus is manifested by a vascular gelatinous film, which extends from the upper periphery of the cornea towards its centre between the epithelium and Bowman's membrane. At an early stage follicles can be detected at the corneal periphery; when these cicatrize they leave small pits, or punctate depressions, situated in a ring round the circumferences of the cornea, or more usually at its upper part only. There are some cases of cured trachoma in which the only signs of the disease having ever existed in the eye are these little punctate depressions, or the persistence of pannus vessels.

The depth of the fornix in trachoma diminishes by contraction of the conjunctiva, the normal folds of which disappear in this situation.

The upper eyelids of persons who have or have had trachoma at all severely present a characteristic appearance. The outer third of the lid margin is slightly concave downwards normally, but in trachoma it is distinctly convex downwards, giving the whole length of the upper lid a sinuous appearance.

A varying degree of ptosis is constantly present in severe cases of trachoma. This is due in part to the increased weight of the upper lid from the thickening of the tarsus and conjunctiva, but is also due to the infiltration of a levator muscle of the upper lid with trachomatous exudate, and the subsequent paralysis of the muscle. This muscle is called *musculus tarsalis superior*, Muller's muscle, and consists of unstriped fibres. In descriptions of Heistrath's combined excision operation directions are usually given to avoid injury to this muscle when the conjunctiva of the fornix is incised. The muscle, however, is usually invisible in severe cases of trachoma, though sufficiently obvious in early cases.

Depreciation of vision may be the result of one of several agencies :

(1) Pannus ; this in favourable cases clears up almost entirely, though the atrophied remains of pannus vessels can usually be seen throughout life. When, however, the vascular granulation tissue has invaded and destroyed Bowman's membrane, permanent opacity results. In some cases the stroma of the cornea is invaded and thereby weakened, and it then gives way before the normal intraocular pressure, allowing the formation of conical cornea or of staphyloma.

(2) Ulceration ; this is usually the result of trachomatous affection of the cornea. In other words, the extension of vascular granulation tissue, or pannus, beneath the corneal epithelium, results in the destruction of the latter and ulceration results. The explanation of these ulcers as the result of the rubbing of the roughened lids on the cornea is usually untrue. Ulceration as the result of a superadded conjunctivitis may occur ; it will be discussed later. Depressed areas which do not stain with fluorescein are frequently seen on the cornea. They may be healed ulcers, but more usually are the result of the absorption of the pannus granulation tissue which causes depression of the superjacent epithelium.

## 5. ACUTE CONJUNCTIVITIS COMPLICATING TRACHOMA.

This subject may be studied in the following subdivisions :

(a) Caused by the gonococcus :

1. Ophthalmia neonatorum and acute gonococcal conjunctivitis of young children.

2. Gonococcal conjunctivitis :

*a.* Acute.

*b.* Subacute.

*c.* Chronic.

(b) Caused by the diplobacillus of Morax-Axenfeld.

(c) Caused by the Koch-Weeks bacillus.

(d) Caused by other organisms.

(a) *Caused by the gonococcus.*

1. OPTHALMIA NEONATORUM. In Egypt gonococcal ophthalmia neonatorum is very rare according to most medical observers. Nevertheless gonorrhoeal urethritis among adults is extremely frequent. As it is quite the exception for infants to be delivered by a medical man, or to be seen by one until some time after birth, it appears to be unwise for medical men to make dogmatic assertions as to the incidence of the disease. Many children of from fifteen to thirty days old have been brought to me at various places in Egypt with perforated corneae and in the process of recovering from acute conjunctivitis, probably gonococcal in origin.

The acute gonococcal conjunctivitis of young children does not differ from that of new-born infants; one description will therefore serve for the two conditions.

*Symptoms.* The disease may manifest itself two, three, four, or five days after birth. One eye is affected first and the other after from one to seven days. The condition usually becomes bilateral sooner or later, but occasionally one eye only is affected. The earliest sign is said to be a narrow red transverse line on the conjunctiva of the upper lid. Generally, however, the first thing noticed is a slight tumefaction and redness of the lid margins, which when gently separated allow the escape of a drop of thin discharge which is sometimes bloodstained. Later the eyelids become hot, red, swollen, glazed and tense. The heavy upper lid frequently overhangs the lower; or it may become everted after the disease has been present some time, exposing to view the dark-red mucous membrane rendered shaggy in appearance by the formation of pseudopapillae, the result of epithelial proliferation.

The ocular conjunctiva, although exhibiting some degree of inflammatory oedema or chemosis, does not overhang the cornea, as we shall see later is usually the case in the gonococcal ophthalmia of adults.

If the case is untreated the discharge, which may be extraordinarily copious, continues for a varying period, at the end of which time when the infant first opens his eyes, the corneae are usually seen to have become perforated, as the result of ulceration.



Rapid cure usually follows ulceration of the cornea and prolapse of the iris, both in ophthalmia neonatorum and in the gonococcal ophthalmia of adults.

Blindness is the common result of such cases. In the lesser degrees of ulceration with perforation of the cornea but without prolapse of the iris, escape of the aqueous humour allows the lens to come in contact with the back of the cornea. As a reaction to this physical, and even toxic, contact, anterior capsular cataract follows; there is a proliferation of the epithelium lining the capsule at the region of the anterior pole. Sub-capsular cortical degeneration over a limited area also takes place, and into this degenerative cortex the epithelium proliferates. The morbid process is distinctly localized. In course of time fibrosis and lamination occur, in association with a further proliferation and extension of epithelium in such a manner as to pass posterior to the fibrous opacity. In the course of one or more years a hyaline tissue is secreted from these cells upon their anterior surface, whereby section of an anterior capsular cataract usually presents the appearance of a circumscribed mass of semi-fibrous tissue surrounded by a capsule and lined posteriorly by lenticular epithelium.

The spot on the cornea where ulceration took place remains opaque as a nebula or leucoma. Occasionally a fine strand of tissue unites the nebula with the opaque spot on the lenticular capsule. This form of cataract is stationary and does not extend to the substance of the lens.

Such cases are the more severe ones; less acute or catarrhal forms are also seen. In the latter a general corneal haze is very common; they often rapidly clear up under treatment. The acute stage is frequently followed by a chronic conjunctivitis.

When healing occurs after ulceration of the cornea with prolapse of iris an adherent leucoma results. This adhesion of part of the iris to the cornea when very slight in degree is called an anterior synechia. Either of the conditions is likely to lead after healing has occurred to a pathological rise in the tension of the eye. The result in infancy is a giving way of the coats of the eye before the increased pressure; this may occur anteriorly, anterior staphyloma; or in the ciliary region, ciliary staphyloma;

or the eye may increase as a whole, the condition called buphthalmos. In any case, blindness results unless the tension is relieved by trephining or by iridectomy as soon as it becomes manifest. In all such cases of recently formed anterior synechia or adherent leucoma, it is wiser to do a prophylactic operation, before any rise of tension becomes manifest. The operation of iridectomy may be satisfactorily performed with a keratome if there is sufficient depth of anterior chamber for the safe passage of this instrument; the portion of iris removed should be torn from its ciliary attachment, two snips with the scissors being required for its separation from the rest of the iris. If the anterior chamber is shallow the corneo-sclera should be trephined and an iridectomy done through the trephine hole.

The corneal opacity may lead to nystagmus, strabismus, or amblyopia. Panophthalmitis rarely results from ophthalmia neonatorum. In many severe cases the preauricular lymphatic gland which is in direct communication with the orbit becomes inflamed, and rarely suppuration may occur. Gonorrhoeal arthritis and septicaemia are not common in Egypt.

The corneal haze above described is the precursor of pannus in most cases (in non-trachomatous ophthalmia neonatorum, however, the corneal haze may clear up rapidly under treatment). When the acute stage subsides the presence of follicles can be detected.

Scarring of the conjunctiva is characteristic. The conjunctiva of the upper fornix exhibits a thin bluish-white scar which, however, does not extend to the tarsal conjunctiva. The retro-tarsal fold is frequently prominent as a ruck in the conjunctiva. Crescentic lines of scarring may be seen which follow the contour of the lower lid. Rarely the scarring is much denser, involving the tarsal conjunctiva of the upper lid as well as the fornix and the conjunctiva of the lower lid; or it may be very localized and show irregular branchings. Such scarring is the result of the gonococcal inflammation; trachomatous scarring is very different and takes longer to develop.

Scarring of the conjunctiva may be also caused by the use of caustics such as silver nitrate stick, in the treatment of the acute ophthalmia.

2. GONOCOCCAL CONJUNCTIVITIS has been divided by Meyerhof into acute, subacute and chronic.

a. *Acute gonococcal conjunctivitis* (blennorrhoeic form). The following description would be typical of this variety:

A man is led into the clinic with swollen, tense, shiny, closed lids, from which he is continually wiping away pus with a handkerchief. There may be difficulty in separating the lids sufficiently to get a view of the cornea, which is probably hazy and surrounded by a raised edge of chemosed conjunctiva under which a ditch-like ulcer frequently develops. If the exudation is excessive the conjunctiva may have become anaemic and grayish-yellow in colour. In cases of such severity the cornea commonly quickly becomes ulcerated or may even slough.

There is previous to the full development of the condition described above an incubation period of varying duration, from a few hours to a few days, during which the lids and the conjunctiva are oedematous, but as yet there is no purulent discharge. There may be a serous discharge, containing a few flakes of pus, and perhaps stained with blood.

In cases of special virulence the superficial cells of the conjunctiva may become so quickly destroyed that a membranous condition may be produced. The majority of the cases, however, are of a less acute type, though during the summer corneal ulceration nearly always occurs and the ulcers generally perforate.

There are several factors in the production of corneal ulceration in acute conjunctivitis. They are as follows:

- (1) Direct action of the gonococci on the corneal epithelium.
- (2) Accidental denudation of the epithelium, allowing the direct action of the gonococci on the corneal stroma.
- (3) Injury to the cornea by being steeped in discharge.
- (4) Deficient nutrition of the cornea resulting from the stasis in the chemotic conjunctiva cutting off the supply of nutrient lymph: necrosis being caused.

b. *Subacute gonococcal conjunctivitis* (catarrhal form) cannot clinically be distinguished from any severe attack of conjunctivitis of non-gonococcal origin. It can be diagnosed only after the microscope has shown the presence of gonococci.

There is a considerable amount of muco-purulent discharge. Ulceration of the cornea may occur, but not so universally as in the acute form, nor is it so commonly followed by perforation. The corneal complication may be confined to a slight exfoliation of epithelium. A localized infiltration or general corneal haze is very common, which may clear up under treatment but is more commonly the precursor of pannus.

c. *Chronic gonococcal conjunctivitis* (metablenorrhoeic form) is the sequela of an untreated acute attack. The acute attack usually lasts several weeks and is succeeded by a condition of chronic inflammation of the conjunctiva, which presents alternate phases of remission and of exacerbation. The suppuration may continue for three or four months or even longer. A papillary hypertrophy of the conjunctiva is present which manifests itself by a velvety granular appearance. The previously discrete trachoma follicles are rendered ill-defined and swollen by the gonococcal infection, so that the diagnosis between a chronic gonococcal conjunctivitis and the simultaneous reaction of both trachoma and gonococci on the conjunctiva may be difficult or impossible clinically. Chronic gonococcal conjunctivitis is characterized by the frequent transmission of the infection in a more virulent form by the patient to members of his family. It has been suggested that the epidemics of acute conjunctivitis are not so serious or so frequent in Egypt as they were thirty years ago. If this is the case, which is doubtful, either the gonococcus must have become less virulent than it was formerly, or trachoma must have become more ubiquitous, the cornea being now more usually protected by pannus.

In cases of trachoma where, as the result of superadded gonococcal infection, the conjunctiva becomes tumefied, the condition of tumefaction may last for a long time after suppuration has ceased. This condition, which has a definite clinical entity, may be called trachoma IIc. Meyerhof calls it *florid trachoma*, which also expresses the condition well. It is among young children that the condition is found most frequently. Gonococcal conjunctivitis of children and adults though so frequently seen in Egypt is rarely accompanied by gonorrhoeal urethritis. Infection must therefore in most cases have occurred from eye to



eye. There is a chronic gonococcal conjunctivitis which is occasionally seen during the winter, while the acute gonococcal conjunctivitis is generally seen in the hot weather—July to October. The organism may therefore persist during the winter months on the conjunctiva of various sufferers without the necessity of a sojourn on the urethral mucous membrane.

In Egypt the atmospheric temperature in May begins to rise above 24 degrees C., but it is about two months after this, in July, that the temperature rises above 28 degrees C., and that the multiplication of gonococci increases and acute cases begin to be seen. There is a second and more severe outbreak of gonococcal conjunctivitis in September, though the temperature is beginning to show an autumnal decline.

In Palestine the epidemic of ophthalmia commences annually in July. The proportion of cases increases rapidly in August, when, as regards numbers, the epidemic is at its height. After August the percentage of these cases falls, but the virulence increases till November. In November and December the cases are fewer in number, but they are of a graver type (Butler).

*Mutual influence of trachoma and gonococcal conjunctivitis.* The following statements may be enunciated as riders to our previous clinical descriptions.

(1) The presence of trachoma predisposes the conjunctiva to infection by gonococci.

(2) The presence of trachomatous pannus to some extent protects the cornea from the destructive effects of gonococcal conjunctivitis.

*Bacteriology.* On microscopical examination the gonococci are generally found to be intracellular during the first 15 days of the affection. They are found to diminish under the influence of treatment and become extracellular before disappearing altogether. In untreated cases they may be found in very large numbers about the third or fourth week of the affection, generally extracellularly.

When combined with other organisms such as the Koch-Weeks bacillus, the diplobacillus of Morax-Axenfeld or the pneumococcus, it is the gonococcus which resists treatment the longest, the other organisms disappearing more quickly.

(b) *Caused by the Diplobacillus of Morax-Axenfeld.*

This bacillus is present in about 50 per cent. of the cases of trachoma (Meyerhof), in the majority of these cases it merely adds to the general amount of chronic conjunctivitis, it may however produce acute inflammation. The change from trachoma I to trachoma IIb is perhaps in some cases affected by its agency.

The clinical signs of an acute attack of conjunctivitis due to this organism do not materially differ from an acute or subacute attack by the gonococcus and the treatment is the same with the addition of zinc sulphate drops.

When the organism gives rise as it more usually does to a chronic inflammation the clinical appearance is a reddening of the inner angle of the eyelids, an angular or blepharo-conjunctivitis. Both eyes are almost always affected. There is a variable amount of discharge which macerates to some extent the reddened skin. A grayish slime on the caruncle is all that is sometimes seen of discharge. Corneal ulceration is not infrequent. The treatment should always include the instillation of drops of zinc sulphate solution  $\frac{1}{2}$  per cent. which is a specific remedy for the condition: the trachoma should be treated separately according to the stage of the disease. Vaccine treatment if available may be used in addition.

*Bacteriology.* The bacilli are usually very numerous; they are large, generally occur in pairs, and often in chains. They do not possess a well defined capsule. They are decolourized by Gram's method of staining.

The subepithelial layer of the conjunctiva is the seat of an inflammatory exudate. In chronic cases connective tissue formation occurs.

(c) *Caused by the Koch-Weeks bacillus.*

The rise of the atmospheric temperature which occurs each year in the month of May coincides with the appearance of acute conjunctivitis caused by the Koch-Weeks bacillus. This variety of conjunctivitis is most frequently met with in May and June and also in September.

Clinically the condition cannot always be distinguished from any other acute conjunctivitis. But the occurrence of small haemorrhages of the conjunctiva, or the presence of slight

pseudo-membranes are considered to be characteristic. Phlyctenular outbreaks often accompany the infection.

The cornea is rarely affected and then only by small gray superficial infiltrates. Clear facets of the cornea are however frequently seen both in Koch-Weeks conjunctivitis and in that due to the pneumococcus. They look as though a small piece of the cornea had been removed with a sharp gouge. They have a shelving edge and are never more than quite superficial. In Palestine, according to Butler, the Koch-Weeks bacillus is more frequently causative of corneal ulceration than the Morax-Axenfeld bacillus; the contrary has been observed by Meyerhof in Egypt. The preauricular glands are sometimes enlarged.

The treatment is the same as in acute gonococcal ophthalmia. Vaccine treatment may be used in addition.

*Bacteriology.* In film preparations the bacilli are found lying between the leucocytes and also within the protoplasm. They are very short fine rods staining less deeply than the nuclei of the cells. They are often found lying end to end, so as to form chains of two or three links, or side by side. The ends are rounded and show a deeper polar staining. The number varies greatly according to the period and intensity of the infection. The bacilli are decolourized by Gram's method; they stain faintly with aniline dyes.

The organism may persist in the conjunctival sac for a long time after the acute stage of the inflammation has ceased, keeping up a chronic inflammation. From such a focus contagion may be conveyed to other subjects, giving rise again to acute conjunctivitis.

*(d) Caused by other organisms.*

The occurrence of acute trachoma of the new-born or trachomatous ophthalmia neonatorum is now apparently undoubted, though this condition has not come within the range of my experience. The infection occurs during the passage of the infant's head through the maternal vagina, of which the mucous membrane is trachomatous. The conjunctivitis usually starts in one or both eyes six or eight days after birth; when only one eye is affected at first, the second eye usually becomes infected later. It rarely causes ulcers of the cornea.

Besides the Koch-Weeks bacillus above mentioned the following organisms may lead to the formation of a membrane which adheres

more or less closely to the subjacent conjunctiva, the Klebs-Löffler bacillus, the pneumococcus and the streptococcus. Differentiation can frequently only be made by bacteriological examination.

**KLEBS-LÖFFLER BACILLUS.** This organism is liable to attack the eyes of young and weakly subjects who are exposed to infection by diphtheria.

The condition is characterized by oedema of the lids of varying degree. The oedema may reach such a pitch that the lids become quite hard. Under such conditions localized necroses of the mucous membrane may occur from obliteration of the blood supply and severe cicatrization may result. A grayish white membrane forms on the conjunctiva of the tarsus, which adheres fairly closely, but can be detached with forceps, leaving the conjunctiva beneath red and bleeding; the membrane consists of clotted fibrin in which the pus cells and a few epithelial cells are embedded; after being detached it reforms.

In some cases the oedema is more marked and in others the formation of membrane. The oedematous form is much the more serious on account of the liability of the necrosed conjunctiva to cause symblepharon or entropion on cicatrization. The cornea is in greater danger in the oedematous form than in the membranous, since the entire conjunctiva may become infiltrated and rigid, leading to sloughing of the cornea; localized infection and ulceration of the cornea may also occur in the membranous form.

In a case of membranous conjunctivitis, the cause of which may perhaps be the Klebs-Löffler bacillus, an immediate dose of 4000 units of diphtheria antitoxine should be given hypodermically; and the usual local treatment for an acute conjunctivitis should be ordered.

In the meantime a bacteriological examination should be made and if the Klebs-Löffler bacillus is found to be the cause of the condition a second injection of serum hypodermically should be made six hours after the first injection. Severe cases or cases which do not come under treatment early should receive double or treble the above mentioned doses. When the membrane separates, the soft and succulent conjunctiva should continue to be lightly painted with silver nitrate solution 2 per cent.

*Bacteriology.* The bacillus has the shape of a slightly curved



rod with rounded ends. It stains well with methylene blue, and is not decolourized by Gram's method. This bacillus is almost identical morphologically with the Xerosis bacillus, which is perhaps a non-virulent form of the Klebs-Löffler bacillus.

**PNEUMOCOCCUS AND STREPTOCOCCUS.** These may produce the same clinical signs as the diphtheria bacillus. The treatment should be the same as for the gonococcal ophthalmia: the appropriate vaccine treatment may be used in addition.

Membranous conjunctivitis may have other than bacteriological causes. Any chemical irritant may cause it such as silver nitrate and perchloride of mercury when applied therapeutically in too strong solution or too frequently; or the accidental instillation of ammonia. The thrush fungus also may produce a membrane-like appearance.

Conjunctivitis may also be caused by Staphylococcus, Xerosis bacillus, Bacillus Coli Communis, Influenza bacillus (Pfeiffer), Bacillus Pyocyaneus. Conjunctivitis thus produced has no pathognomonic signs, except in the cases of the Bacillus Pyocyaneus which produces a blue colouration.

## PART II.

### PATHOLOGY OF TRACHOMA.

#### A. MORBID ANATOMY.      B. THE ACTIVE AGENT.

##### *A. Morbid Anatomy.*

The Morbid Anatomy of trachoma will be discussed under the following heads: (1) follicles or granulations, seen typically in trachoma I and trachoma IIa, (2) papillae, seen in trachoma IIb, (3) cicatricial tissue, seen in trachoma III and trachoma IV, (4) pannus seen in every stage, (5) degeneration of the conjunctiva.

(1) Follicles. The micro-histology of a follicle somewhat closely follows the clinical features of an attack of trachoma; that is to say, fibrous elements make their appearance in proportion to chronicity. In an early follicle the epithelium covering it may be so thinned as to be almost non-existent, and polymorphonuclear cells may be noticed amongst the strata. Rupture of the epithelium is associated with spontaneous extrusion of the follicle.

The follicles lie in the subepithelial tissue, which is further involved in a more or less general infiltration. In the early stage a capsule is suggested by the presence of elongated flattened cells at the periphery; internal to this is a conglomeration of lymphocytes, the centre being composed of less deeply staining cells, many of which are of the large epithelioid type, and present the appearance of cells undergoing degenerative or necrotic transformation. Here and there thin walled vascular channels can be demonstrated. Plasma cells are not a feature of the trachoma follicle, in contrast to the lymphoid follicle. They may however be demonstrated and are invariably found in considerable numbers in the subepithelial tissue.

Older follicles have a more or less definite connective tissue capsule, more fibrous stroma and vessels, and much the same

lymphoid aggregations. Mast cells are sometimes conspicuously numerous. These are either mono- or polynuclear cells, of ordinary size, the cytoplasm of which has strongly basophilic properties, that is to say there are certain granules of the protoplasm which have a special affinity for the basic radicle of certain aniline dyes, such as haematoxylin and methylene blue.

The end of a follicle may be in one of three ways (*a*) gradual change into tough connective tissue with absorption of the contents of the follicle, (*b*) rupture of the follicle on its epithelial surface, evacuation of its contents and cicatrization, (*c*) further development of capsule, cutting off of blood supply and resulting necrosis of contents of the follicle; this necrotic process occurs to a greater or less extent in all cases of cicatrizing trachoma and is known as *post-trachomatous degeneration*<sup>1</sup>; the semi-liquid necrotic contents may calcify.

(2) Papillae seen in trachoma II. These are always accompanied by follicles though the latter may not be obvious microscopically.

The papillary growths are caused by an increase in the surface area of the hypertrophic conjunctiva. The latter is thrown into folds, between which correspondingly deep clefts are formed; then on cross section the folds appear as papillary ridges. The connective tissue forming the papillae is stuffed full of round cells; the surface of the papillae is covered with a very much thickened epithelium which of course is continued on into the depressions that exist between the papillae. These depressions have thus in microscopical cross section the appearance of narrow canals lined with epithelium and were accordingly regarded at one time as tubular glands; and hence the formation of new glands was alleged to occur in trachoma.

Papillary hypertrophy as above described is not pathognomonic of trachoma; it is found in any condition of long continued irritation of the conjunctiva such as results from ectropion, spring catarrh, and chronic conjunctivitis.

Meyerhof has shown that the papillary variety of trachoma may be trachoma complicated by spring catarrh. At the present

<sup>1</sup> This excessively frequent condition, *post-trachomatous degeneration*, is commonly abbreviated to "P. T. D." at the Egyptian Ophthalmic Hospitals.

time therefore we clinically recognize two conditions: papillary trachoma (trachoma IIb') and trachoma complicated by spring catarrh (trachoma IIb'') while pathologically they are identical.

(3) Cicatricial tissue. The process of disappearance of the follicles with development of trachoma III has already been partially described under the heading of follicles. The new formed connective tissue, which was developed as a result of the inflammatory exudate in the follicles and papillae, undergoes gradual shrinkage, which ultimately leads to obliteration of both structures.

The process of cicatrization of the tarsus is most important. In all severe cases of trachoma the disease is just as much in the tarsus as in the conjunctiva. The cartilage is thickened by an inflammatory exudate which is replaced by connective tissue during the process of healing. As in every other part of the body, the connective tissue thus laid down undergoes contraction. The shrinking of the connective tissue in the tarsus and in the conjunctiva leads to a deformity of the eyelids in many cases producing *entropion*.

There are several reasons why inversion of the margin of the lid or entropion usually occurs, and not eversion, as the result of cicatrization. (a) Any change in form of the tarsus as the result of shrinking will be in the direction of an increase of its vertical concavity, for it is in this direction that the shrinking force will act with dynamic advantage. (b) The exudation into and the thickening of the tarsus are greater near its lower margin, where it is perforated by the numerous blood vessels which are distributed to the conjunctiva. Cicatrization is greater at the seat of greatest exudation, that is on the inner side of the tarsus between it and the conjunctiva, at the site of the normal subtarsal sulcus. In this situation a line of cicatrization occurs, the so-called Arlt's line, as a result of which the free margin of the lid is curved inwards. The lash-bearing area necessarily suffers the same displacement. The margin of the lid has by this time altogether lost its normal sharpness and has become rounded. Cicatrization of the conjunctiva is not an indispensable factor in the production of entropion, for cases are sometimes met with in which there is entropion without any visible cicatrix of the conjunctiva.

Trichiasis is the name given to that condition in which the eyelashes assume a false direction as a result rather of the hyperaemia of the lid margin than of the cicatricial process just described. It is a matter of common clinical observation that the number of lashes is increased in some cases of trichiasis and it is frequently possible to distinguish different sets of cilia. The supernumerary lashes are developed as buds or offshoots from the pre-existing follicles.

These false cilia may be directed either inwards, producing as has been said trichiasis and its attendant danger, or they may be directed outwards, leading to a development of hairs above the true eyelashes on the outer surface of the lid.

As the result of the cicatricial degeneration of the conjunctiva *xerosis* may occur. As its name implies, it is characterized by dryness of the conjunctiva. In slight cases small triangular patches are seen on the conjunctiva or on the cornea, which are covered with a white substance like foam or beaten up white of egg. It is easily removed but is reproduced in about a day. These patches consist of epithelial proliferations.

In cases of lagophthalmos, the result of ill-considered operations for trichiasis, the whole cornea may become opaque from the desiccation or proliferation of the superficial cells. Later the epithelium may become epidermoid in nature. Many Xerosis bacilli are found, both intra- and extra-cellularly, which grow rapidly under the conditions which exist, but are not the cause of the condition. No connection has been made out in Egypt between xerosis and night-blindness.

(4) Pannus is trachoma of the cornea and manifests itself as a layer of vascular tissue which spreads from the limbus on to the cornea. The development commences at its upper part, the contagion spreading directly from the superjacent upper lid by contiguity of tissue. Trachoma follicles are found on the cornea at its periphery, situated between the epithelium and Bowman's membrane, between which layers it is that pannus develops. These may be recognized at an early stage as small elevations; when they become cicatrized they persist throughout life as small pits or depressions situated at the periphery of the cornea, affording absolute evidence, if it is required, of the pre-existence of trachoma.



Pannus (Latin for "a cloth") in severe cases spreads all over the cornea between the epithelium and Bowman's membrane, and may interfere with vision. In some cases it appears as a thick fleshy growth; in others it can only be detected by examination with the corneal microscope.

The vascular pannus derives its blood supply from the vessels of the conjunctiva which can be seen to cross the limbus and traverse the cornea branching in an arborescent fashion underneath the epithelium. The healthy cornea contains no vessels. These cease at the margin of the cornea forming a network of marginal loops supplied from the vessels of the conjunctiva. From the marginal loops the rest of the cornea is nourished by the exudation of lymph. These marginal vessels are normally limited to a narrow peripheral zone  $\frac{1}{2}$  to 1 millimetre wide at the sides and 1 to 2 millimetres wide above and below. In the development of pannus new vessels are formed from the convexity of these marginal loops which proceed centripetally, i.e. in the same direction as the blood and lymph stream, towards the centre of the cornea; the vascular development is accompanied by an inflammatory exudate of cells.

Pannus of moderate degree is capable of retrogression so that the cornea can again acquire its normal transparency. But although the new formed vessels shrink and become invisible to the naked eye in favourable cases, they usually remain visible with the corneal microscope. They fill up with blood again when sections of the cornea are made for the purpose of cataract extraction, etc., and reproduce much of the former opacity of the cornea; this again may clear up after healing of the wound.

In some cases of trachoma Bowman's membrane becomes destroyed in places, and then the cellular infiltration gaining access to the stroma of the cornea gives rise to permanent changes in its transparency and curvature. The cornea becomes smooth on the surface and the vessels almost disappear, so that the cornea is covered with a thin layer of connective tissue which permanently depreciates the vision.

Another result of pannus, sometimes, is a bulging of the weakened cornea which gives way before the normal intraocular tension producing conicity or staphyloma. Unlike idiopathic

keratoconus, trachomatous conicity when operated on rarely results in visual improvement.

(5) Degeneration of the conjunctiva. The conjunctiva is made up of an epithelium and of a substantia propria. The epithelium is of the laminated cylindrical type with here and there glands and goblet cells. The substantia propria consists of adenoid connective tissue; the reticulum of fibrous tissue contains many lymphocytes in its meshes especially in the superficial layers, so that a division is sometimes made into a superficial adenoid and a deep fibrous layer.

Occasionally in cases of trachoma the epithelium becomes thickened, more by swelling of the cells, than by increase in their number; and at the same time the small celled infiltration of the substantia propria degenerates in patches into homogeneous masses which may fuse together. These masses are formed from the non-living products of living cells and are chemically of an albuminoid nature. This is colloid degeneration; it is sometimes wrongly called amyloid degeneration, but it is of entirely different origin to the degeneration which occurs in amyloid disease, the result of chronic absorption of septic products. Tissue which shows true amyloid change gives a characteristic reaction with iodine, becoming stained of a mahogany brown colour. This colouration I have never obtained in trachomatous colloid degeneration.

*Clinical appearance.* Friable masses of apparently structureless material are found on the conjunctival surface of the upper lid, in the fornices and about the caruncle; occasionally the bulbar conjunctiva is affected. These masses have the consistence of a half cooked potato. The upper lid is more frequently affected than the lower. A mass of tissue in the region of the caruncle is sometimes the only evidence of the disease.

In severe cases, not merely the palpebral conjunctiva but the subjacent tarsus is entirely destroyed by this degeneration, and the lids are transformed into large deformed swellings. In such cases no treatment is of any avail. In slight cases the diseased tissue may be removed by scraping or Heisrath's combined excision operation may be performed, but the addition of a large mucous membrane graft is generally required as it is impossible to bring down the friable conjunctiva to the lid margin.

The condition is not very uncommon in Egypt; I have never seen a case in which there was no evidence of old trachoma.

*B. The Active Agent.*

In few other infectious diseases has the aetiologic agent been ascribed to so many different micro-organisms by different investigators. At the present time however consideration need only be given to Prowazek's "cell inclusions" and to Lindner's "initial bodies."

Prowazek's cell inclusions are dark blue granular inclusions in the protoplasm of epithelial cells seen when trachoma smears are stained by Giemsa's method. At first small, round or oval, they apparently grow, become less dark, and then fine red points appear in the masses. The red points increase rapidly in number, the blue masses gradually disappear. Prowazek (with whom Halberstaedler was working) called the blue masses *plastin* because he thought them to be a reaction product formed by the action of the virus upon the cells, and which he thought to be represented by the red points. His reason for thinking this was that the blue masses are very indistinct, and gradually disappear upon the multiplication of the red points. These red points were also found extracellularly. Anthropoid apes inoculated with trachoma showed the same findings. By these investigations the author was convinced that trachoma is an epithelial cell infection like variola and molluscum contagiosum.

Lindner's "initial bodies" are blue sharply outlined round cocci-like bodies seen in the cavities of the protoplasm of the epithelial cells. They multiply by special division and later on are found only near the wall of the cavity at a time when red points appear in the cavities. These initial bodies are found not only in the cells but extracellularly. Prowazek's inclusions are nearly always accompanied by these free initial bodies. For this reason Lindner believes that the initial bodies and the red points called the elementary bodies are alive, i.e. they are living organisms and that the virus belongs more to the protozoa than to the class of variola or molluscum contagiosum.

It is now known that non-gonococcal ophthalmia neonatorum does occur, and in nearly all cases Prowazek's inclusions are to be found. The inclusions are rarely or never found in gonococcal ophthalmia neonatorum. The genital epithelium of a woman



whose child had had non-gonococcal ophthalmia neonatorum was found to contain exactly similar cell inclusions. The inclusions have also been found in the non-gonorrhoeal urethritis of men. The conjunctiva of monkeys has been inoculated from trachoma, from non-gonococcal ophthalmia neonatorum, from non-gonococcal vaginitis, and from non-gonococcal urethritis and in each case an infection quite similar to the one in trachoma is produced. If this is so there can be no further doubt that we may have trachoma of the genital passages in men and women, and also trachomatous ophthalmia neonatorum.

It should be noted that after filtration through a Berkefeld filter of infective material in suspension in water, the filtrate has been found to be still infectious, although none of the bodies described above were visible. The explanation is that the smaller ultra-microscopic bodies passed through the filter, but this is purely hypothetical. Such is the highly indeterminate position of the trachoma question at the present time, March 1913.

A conjunctivitis has been described by Cohen which is very similar to trachoma but has an acute onset and heals without pannus formation or cicatrization of the conjunctiva. It is characterized by the constant presence of Prowazek's inclusions.

## PART III.

### 1. TREATMENT OF TRACHOMA.

THE process of cure of trachoma usually depends on the laying down of fibrous tissue which in large measure replaces the follicular conjunctiva. In trachoma I, however, absorption of the individual follicles may occur. The kind of treatment to be adopted depends on the stage of trachoma in each case. In treating the disease it must be remembered that in most cases of long standing, the tarsus is affected as well as the conjunctiva, and the application of drugs to the conjunctiva cannot be expected to readily influence the trachomatous thickening of the tarsus.

Much has been made of the value of general treatment. We know that disease of any kind is more easily shaken off when the patient has a sufficiency of food and air and a sanitary habitation. But the effect of the treatment of trachoma II on two patients, the one living under good conditions, and the other under bad conditions, but without actual malnutrition or disease or excessive exposure to dust, is not very different.

The period during which treatment must be kept up varies. The treatment of trachoma in private practice is a difficult one, more especially in heavily trachomatized countries. A daily visit to a surgeon for several months, which entails the payment of a fee on each occasion, is rarely carried out. The disabilities attaching to trachoma I after excessive conjunctival discharge has been stopped are so slight, that neither private nor hospital patients usually continue their attendance for further treatment. The results of active treatment by escharotics of trachoma I when there is little discharge are poor in large clinics, the condition frequently being made worse. Most cases of

trachoma IIa can be transformed into trachoma III within 15 days; the subsequent transformation into trachoma IV being any time from one month to several years. When trachoma III has definitely been reached active treatment should be much modified.

The radical cure of trachoma by Heisrath's combined excision operation is applicable to any stage of trachoma, provided the fornical conjunctiva is in a cicatricial condition as the result of previous gonococcal conjunctivitis, or of partially healed trachoma. Its use however is restricted since its performance, except by an experienced surgeon, is quite unjustified.

In no conjunctival affection whether trachomatous or purulent should the eye be tied up, not even when the cornea is ulcerated.

When the palpebral fissure is narrowed either congenitally or as the result of cicatrization it is necessary to enlarge it permanently by operation before treatment of the conjunctiva can be carried out satisfactorily (see canthoplasty).

### *Trachoma I.*

If there is a discharge, nitrate of silver solution 2 per cent. is rubbed on the everted lids daily with a pledget of cotton wool on the end of a glass rod. A fresh rod is used for each eye, which after use is placed in an antiseptic solution and left there until it can be sterilized by boiling.

The action of silver nitrate is due to a coagulation of the albumin of the superficial layer of the conjunctiva which becomes white. A transudation from the blood vessels occurs under the coagulum, which is thrown off containing the superficial epithelial cells and conjunctival bacteria. This action of silver nitrate is not imitated by any of the organic silver compounds argyrol, protargol, etc., the use of which is merely palliative.

Occasionally patients are willing to continue treatment in trachoma I after the discharge has ceased. In such cases the application of copper sulphate stick may give good results. The action of the copper is to cause a leucocytosis in the superficial layers of the epithelium.

What usually happens in Egypt is that, the subjective symptoms being cured after a short period of treatment, the

patient refuses to subject himself to it any further. The granulations persist, and as the result of a chance infection with some organism causing acute conjunctivitis, they may spread all over the conjunctiva and become greatly enlarged, the stage developing into trachoma II. The results of the mechanical and medical treatment are much more marked in this stage but the immediate dangers and complications are much more serious and it is never right to artificially induce the development of trachoma II. Trachoma I may also develop into trachoma II spontaneously and without the intervention of acute conjunctivitis.

We treat trachoma I in hospital practice when there is no discharge by the instillation of some kind of collyrium such as:

Zinc Sulphate .....	·5
Perchloride of mercury.....	·02
Pyoctanate of mercury.....	·001
Water .....	100.

This treatment is not painful for trachomatous eyes; if persisted in, the conversion to trachoma III or IV is usually effected in a variable time, though relapses are common.

The patient sometimes refuses all treatment of a painful nature, then protargol 10 to 20 per cent. or argyrol 20 to 50 per cent. may be used by the surgeon. These drugs are said to cause argyrosis if persisted in for a long time; in my experience however they are devoid of danger.

Surgical treatment is not usually indicated in trachoma I; however, radical cure of the disease occasionally may be undertaken by the performance of Heisrath's operation. This operation will be described later. Treatment by means of carbon dioxide snow has been employed by us; it is not suitable for use in a large clinic; it produces considerable cicatrization. Treatment by radium we have found to be without value in Egypt. Subconjunctival injections also are useless.

### *Trachoma II.*

Each of the three divisions *a*, *b* and *c* of trachoma II requires appropriate treatment.

*Trachoma IIa.* The gelatinous granulation tissue is removed by mechanical rupture of the follicles. The instruments used

for this purpose are a small sharp spoon and Graddy's forceps. Excessive bleeding is prevented by the use of adrenaline hydrochloride 1 in 2000. A general anaesthetic is frequently necessary; large numbers of patients, however, can bear the operation under cocaine. The upper lid is everted and scraped with the spoon, carefully and gently. If the fornix is not cicatrized the retrotarsal fold should be seized with a pair of toothed forceps in order to enable the lid to be re-everted; the fornix is then scraped. It has already been said, however, that in the majority of hospital patients in Egypt the fornical conjunctiva is found to be already cicatrized as the result of previous gonococcal conjunctivitis. Graddy's forceps are then applied to the everted conjunctiva; the blades should not be approximated with too much force before they are withdrawn, carrying in front of their concavity the gelatinous contents of the follicles which are ruptured by the passage of the instrument. If too much force is used the conjunctiva will be lacerated. The lower lids should then be scraped in the same way with the spoon. Graddy's forceps are not applicable to the lower lid unless the conjunctiva is loose.

Perchloride of mercury solution 1 per cent. is then applied to the bleeding conjunctiva by means of a small piece of cotton wool on the end of a glass rod. If the operation or the application has been too vigorous some necrosis of the conjunctiva will be found on the next day, shown by the presence of a membrane covering the whitened conjunctiva; if this occurs the subsequent use of escharotics should be deferred until the membrane has disappeared. In ordinary cases the perchloride of mercury should be applied once daily, and improvement should be noted at the end of a week, and at the end of a fortnight the commencement of the change into trachoma III should be observed. At the end of a month a network of cicatricial lines should be seen. This improvement is usually permanent, although in the absence of further treatment, relapse is liable to occur with a re-development of follicles. This treatment may be supplemented by the use of zinc drops, and boracic ointment for anointing the edges of the lids. After 15 or 30 days use of perchloride of mercury, it is sometimes of advantage to change the treatment to light rubbing of the conjunctiva with copper sulphate stick. Tolerance to either of these drugs is



sometimes established after exhibition for 15 days. The action of both drugs is by the causation of a leucocytosis; there is no evidence that either of these drugs, or that any other drug has a direct influence on the trachoma follicle.

The mechanical part of the treatment, the scraping, sometimes needs repeating after about 7 or 15 days. Occasionally a case requires scraping three or four times, but this depends to some extent on how much or how little care has been used in the first and second scraping. Simple scraping of the conjunctiva or scari-fication without the further application of drugs is useless.

The danger of excessive cicatrization and subsequent entropion can be guarded against by intelligent and experienced treatment. It is inevitable however that a certain number of cases under treatment should develop trichiasis or entropion, seeing that the process of cure depends on the laying down of scar tissue. Most hospital patients who apply for treatment have some degree of entropion already which will inevitably become dangerous whether or not it is treated. About 30 per cent. of all the patients who apply for treatment at the Egyptian Ophthalmic Hospitals have definite trichiasis or entropion.

If there is a superimposed conjunctivitis going on, as evidenced by inflammatory signs and purulent discharge, no operative procedure should be undertaken. In such cases the indication is to treat the acute conjunctivitis before attacking the trachoma. In the same way it is not usually wise to operate on trachoma if there is an ulcer of the cornea; the treatment should be by painting the lids with silver nitrate solution 2 per cent. until the ulcer has healed partially or entirely.

When ulceration results from trachomatous invasion of the cornea no special treatment is indicated for the condition. Cauterizations of the cornea whether by the galvano-cautery or by drugs such as carbolic acid, etc. are harmful. Ulceration the result of a superadded conjunctivitis will be discussed later.

In trachoma I the follicles may increase in number and become much enlarged after an attack of gonococcal ophthalmia, the stage trachoma IIa being produced. Now trachoma IIa is much easier to cure than trachoma I owing to the applicability of surgical procedure to the stage of enlarged follicles. However the deliberate



induction of trachoma II by inoculating the conjunctiva in a trachoma I stage with gonococcal conjunctivitis is never indicated, owing to the danger of ulceration to which the cornea would be liable.

It has been said that pannus clears up after an accidental infection with gonococcal conjunctivitis and some surgeons have had the temerity to inoculate with gonococci the conjunctiva of eyes which exhibit a high degree of pannus. However I have never made any observations which support the theory on which this treatment rests.

The inflammatory action of gonococcal ophthalmia can be imitated by jequiritol. This drug has been used with the object of reducing the number and size of the vascular channels in severe cases of pannus. It can be used without much danger as its effects can be controlled by the operator.

The dissection of the superficial vascular layer of the cornea from the stroma, or pannus dissection as it has been called, is in our opinion unsurgical. Nor is peritomy in favour with us; in this operation the conjunctiva is divided with scissors all round the circumference of the cornea.

Treatment of pannus is for the purpose of improving deteriorated vision, but pannus should be recognized to have two varieties or stages. One in which the vascular granulation tissue between the epithelium and Bowman's membrane clears up under the treatment applied to the eyelids, leaving only the attenuated vessels. Another in which Bowman's membrane has been destroyed in places and the corneal stroma has been invaded; here two things have resulted; first a permanent opacity and secondly a destruction of the nutrient lymph flow between the corneal corpuscles by the laying down of scar tissue. The absence of the normal nutriment renders necessary the persistence of pannus vessels. I am therefore totally at variance with some distinguished surgeons on the subject of the treatment of pannus.

Trachoma IIa may also be cured by Heisrath's operation.

*Trachoma IIb'.* The most satisfactory treatment for this condition is radical cure by Heisrath's operation. If the surgeon is not sufficiently skilled to perform this operation without danger, treatment by scraping with a sharp spoon and subsequent application

of perchloride of mercury solution 1 per cent. may be tried, but is not satisfactory.

*Trachoma IIb''* is a tiresome condition to treat. Heistrath's operation has given me good results; it is reported however that in some cases recurrence of the spring catarrh papillary growths have occurred after operation.

*Trachoma IIc* is treated by the application of silver nitrate solution 2 per cent. once daily. In children spastic ectropion of the upper lid frequently occurs (vide ectropion in acute conjunctivitis).

### *Trachoma III.*

The beginning of this stage is best treated by the daily application of perchloride of mercury solution 1 per cent. Later on, copper sulphate stick is used with more advantage, at first every day, afterwards less frequently. In cases in which there is excessive thickening of the tarsus, Heistrath's operation is the only procedure which leads to a cure. This operation also takes away the cause of entropion when present.

Where there are, as is frequently the case, necrotic foci of post-trachomatous degeneration beneath the conjunctiva they should be opened with the point of a knife. When these foci become calcareous the treatment is the same. The lids should subsequently be painted for several days with 1 per cent. perchloride of mercury solution.

It is a mistake to carry on active treatment with escharotics too long in this stage; previous to complete cicatrization astringent drops alone should be used.

### *Trachoma IV.*

This stage which typically is that of complete cicatrization, requires no treatment. In those cases in which absorption of the follicles has occurred without their spread over the whole of the surface of the conjunctiva, prophylaxis against reinfection must be carried out by daily use of astringent drops.

*Operations for the radical cure of trachoma.**A. Heisrath's operation.*

Heisrath's combined excision of tarsus and conjunctiva may be performed for the radical cure of trachoma in any stage, provided that in each case the conjunctiva of the fornix is cicatrized. This is the rule however in Egypt rather than the exception, owing to the prevalence of gonococcal ophthalmia which frequently gives a protective cicatricial component to the conjunctiva in this situation. If the fornical conjunctiva still shows the presence of numerous follicles it may be found too friable for the manipulation required in this operation. But an expert operator can get over this difficulty by inserting a mucous membrane graft from the lip to compensate for the removal of fornical and palpebral conjunctiva. Heisrath's operation may be performed for both upper and lower lids. It is the only procedure which leads to an immediate cure of trachoma. Entropion, the result of thickening and pathological curving of the tarsus, is also cured by the operation.

The operation should only be performed by experienced surgeons; it may be done under cocaine in patients who are not sensitive: otherwise a general anaesthetic is required.

(a) Heisrath's operation, or combined excision, for upper lid.

The lid is everted, seized at both extremities by the assistant with two pairs of fixation forceps and partially everted. A sub-conjunctival injection of adrenaline 1 in 2000 is given at the seat of the future incision (or of adrenaline and cocaine if a general anaesthetic is not being used).

The incision is made horizontally from one lateral aspect of the conjunctiva to the other and at the junction of the diseased and healthy tissues: it should never encroach on the ocular conjunctiva. The conjunctiva alone should be cut through and should be dissected back towards the globe for about 5 millimetres.

An incision is now made through conjunctiva and tarsus along the inner surface of the eyelid which is everted on the entropion spatula. This incision is a sinuous one being at the middle of the

lid about 2 millimetres from the lashes and at the extremities of the lid  $1\frac{1}{2}$  millimetres from the lashes. By cutting somewhat obliquely backwards and upwards the diseased conjunctiva and tarsus may be removed and yet a sufficiently stout cartilaginous rim for the lid may be left. The cartilage is now carefully separated from below upwards with scissors, from the aponeurosis which is visible covering the orbicularis; it is of vital importance to keep close to the tarsus in this dissection. On reaching the upper border of the tarsus the levator tendon is severed with the scissors close to the tarsus. The lateral attachments of the tarsus are divided and then the whole of the diseased tissue will have been cleanly dissected out. The site of the operation is then well irrigated to wash away all blood and the operation is completed by stitching the margin of the bulbar conjunctiva to the rim of cartilage remaining; these sutures are put in from the skin surface so that the knots cannot rub against the cornea; they may be removed 48 hours after the operation. The eyelids should be covered with a light dry gauze dressing spread with boracic ointment.

(b) Heisrath's operation on the lower lid.

The cartilage of the lower lid should not be removed unless it is considerably thickened. In such cases Heisrath's combined excision as previously described may be performed. But the conjunctiva alone may be removed if it is extensively diseased and if the lower fornix is cicatrized, at the same time as the combined excision operation is performed on the upper lid. Excision of the conjunctiva alone is thus performed.

The lid is everted and held in position on the entropion spatula. A posterior incision is made running the entire length of the lid and marking the junction between the bulbar and the palpebral conjunctiva, remembering that the eversion of the lid on the spatula drags the bulbar conjunctiva forward for a considerable distance. The conjunctiva is then dissected back towards the globe for about 3 or 4 millimetres. An anterior incision is now made which connects the two extremities of the posterior incision and runs parallel to, and  $1\frac{1}{2}$  millimetres behind, the eyelashes. The conjunctiva alone is penetrated and the area thus marked out by the incision is dissected off its bed with scissors.



The bulbar conjunctiva is then sutured to the lid margin. The sutures should be put in from the skin surface, so that the knots cannot injure the cornea.

### *B. Kuhnt's operation.*

Cases are sometimes met with in which the tarsus is very much thickened, while the mucous membrane over it is in the stage of trachoma IV. The operation here indicated if the tarsus causes entropion or irritation, is to remove the tarsus while leaving the mucous membrane, Kuhnt's operation. The mucous membrane is found to be no longer firmly adherent to the tarsus and may be stripped off.

The lid is everted on a spatula and an incision is made through the mucous membrane only at the free border of lid. The mucous membrane is then separated from the tarsus until the upper border of the tarsus, in the case of the upper lid, is reached. The further details of the operation are the same as in Heistrath's operation except that no conjunctiva is removed.

With practice these operations may be performed easily, quickly, and successfully. It is by far the most satisfactory way of treating trachoma. Ptosis will not result if the directions given are carried out; the attachment of the levator palpebrae superioris muscle to the aponeurosis in front of the tarsus is an ample safeguard against this. If the sutures which unite the conjunctiva to the tarsal rim at the lid margin are put in carelessly, vascular knobs of conjunctiva will be found in this situation when healing has occurred; if these vascular knobs do not disappear in a week or so they may be touched with the cautery.

The dressing may be removed from the eye after three or four days and the patient may wear protective glasses; the eye should be tied up at night for at least a week.

After a week or ten days the patient is found to open his eyes more widely if there has been trachomatous ptosis previously, the cornea becomes clearer and the vision improves. A patient who has had one upper lid operated upon, after recovering, generally returns to beg to have the other one done.



## 2. TREATMENT OF THE SEQUELAE OF TRACHOMA.

OPERATIONS FOR TRICHIASIS AND ENTROPION. A few general rules may be formulated for the guidance of beginners in these operations:

1. If the conjunctiva requires treatment, this should be carried out before the operation, except in urgent cases such as trichiasis with corneal ulceration.

2. The eyelid should not be fixed in a clamp but should be supported and stretched by a special metal spatula<sup>1</sup>.

3. No skin should be removed from the lid.

4. Fine silk-worm-gut should be used for the sutures and not silk<sup>2</sup>.

5. The operations can generally be performed under local anaesthesia; the solution used by us for hypodermic injection with satisfaction since 1904, is a solution containing 2 per cent. cocaine hydrochloride and 1 in 2000 adrenaline hydrochloride. The operation can be performed almost bloodlessly by this method. If it is necessary or advisable to use general instead of local anaesthesia, a hypodermic injection of adrenaline should be made beneath the skin at the site of operation.

6. It is usually advisable to cut off the eyelashes of the lid to be operated on; in trichiasis, however, the offending lashes should be left untouched.

7. Partial operations for trichiasis should never be performed.

8. The operator should stand behind the patient's head.

9. If the conjunctiva is not fairly well cicatrized the eversion effected by the operation should be slightly over done, or re-inversion may occur with progress in the cicatrization of the conjunctiva.

A large number of operations have been proposed for the relief of trichiasis and entropion, but the only operations which require to be known in order that all varieties of trichiasis and entropion resulting from trachoma may be dealt with successfully are:

1. Snellen's.

2. Anagnostakis' (a) upper lid, (b) lower lid.

3. Van Millingen's grafting operation.

<sup>1</sup> MacCallan's entropion spatula is made by Weiss & Co., London. Landolt also has designed an improved spatula which bears his name.

<sup>2</sup> Black ophthalmic silk-worm-gut. Weiss & Co. or Down Bros., London.

## 4. Electrolysis.

## 5. Canthotomy and Canthoplasty.

The two first operations can be performed easily and successfully by any surgeon. The grafting operation requires some practice.

1. *Snellen's operation.* This operation consists in the removal of a horizontal wedge from the anterior surface of the tarsal cartilage as first proposed by Streatfield. It is especially suitable for cases in which the cartilage is thickened.

The entropion spatula is inserted under the lid and a horizontal incision is made through the skin 4 or 5 millimetres above the lashes. The upper edge is undermined for 2 millimetres, the lower edge is undermined as far as the lashes. The orbicularis is cleared from the tarsus. A wedge-shaped piece of cartilage is removed from the whole horizontal extent of the thickened tarsus in one strip, thus:—an incision half a millimetre deep, perpendicular to the cartilage is made just above the roots of the lashes; an oblique incision is then made 2 millimetres above the first incision and the wedge included between the 2 incisions is then removed. Its base is between the 2 incisions, a thin layer of tarsal tissue only intervenes between the apex of the wedge and the palpebral conjunctiva. Removal of the wedge is begun from the outer side in each eye.

The sutures are now inserted. The needle must be entered through the lower skin flap near to, but above the lashes, and in front of the cartilage. A horizontal bite of the cartilage above the groove formed by the removal of the wedge is taken with the needle, which is returned through the lower skin flap, in a corresponding position to its entrance and 3 or 4 millimetres from it. Four such sutures are inserted; a space of about 2 millimetres is allowed to intervene between each suture. The tarsus being deficient near the inner canthus the horizontal bite is taken through the soft tissue which replaces it as high up as possible.

The wound is washed free of blood and the sutures are tied by a single knot with a double turn so as to lie horizontally. The sutures should be loosely tied at first, being adjusted later; their tightness being proportionate to the amount of eversion required. Excessive tightness causes strangulation and subsequent necrosis of the lid margin. The edges of skin are united with

three or four sutures. A sterilized gauze dressing is carefully applied, which is not removed until the fourth or fifth day after the operation, when the sutures may be taken out, no further dressing being required in many cases.

The border of the lid after healing has occurred will be thick and unsightly if any excess of cartilage is left below the wedge-shaped groove formed by the removal of the strip of cartilage. Care should therefore be taken to leave as little cartilage as possible in the lid margin below the groove.

In a few severe cases the operation as above performed does not give quite sufficient effect. One of two procedures may then be carried out additionally:

(a) Anagnostakis' incision, (b) Cant's cuts.

(a) Anagnostakis' incision is carried out, after the entropion spatula has been reinserted, by making a superficial cut along the whole free border of the lid just posterior to the lashes. It should be  $\frac{1}{2}$  or 1 millimetre deep; owing to the tension exerted by the sutures of the Snellen's operation, the lips of the incision gape apart, allowing further eversion of the lash-bearing area. The greatest care must be taken to avoid leaving any hair bulbs in the posterior lip of the wound. If this happens they must be picked out with the point of the knife. After the first dressing on the fourth or fifth day, a dressing should be reapplied daily until epithelium has covered the raw surface left by the gaping of the Anagnostakis incision.

(b) Cant's cuts. A vertical incision with stout scissors is made through the whole thickness of the tissues of the upper lid at its inner and outer extremities. The incision extends 3 millimetres upwards from the free border of the lid. This procedure allows the more complete eversion of the eyelid, but is rarely necessary. It causes slight deformity after healing has taken place.

2a. *Anagnostakis' operation for the upper lid.* The incision along the free border of the lid formed part of an operation first suggested by Anagnostakis. This operation is suitable for cases in which there is no thickening of the tarsus, and for cases of partial trichiasis.

The entropion spatula is inserted under the lid which is thereby put on the stretch by the assistant. An incision is then

carefully made along the whole free border of the lid immediately posterior to the lashes, but without injuring them. It should be from  $\frac{1}{2}$  to 1 millimetre deep.

If a hair bulb is cut through, the proximal extremity will be seen as a black dot on the posterior surface of the incision, this must be picked out with the point of the knife.

Another incision is now made along the whole horizontal extent of the lid 4 or 5 millimetres above the lashes. The lower edge is undermined down to the roots of the lashes. The upper edge is undermined for 2 millimetres. The orbicularis is cleared off the tarsus. The sutures are now inserted. The needle must be entered through the lower skin flap near to but above the lashes, in front of the cartilage. A horizontal bite of the cartilage near its upper border is taken with the suture and the needle is returned through the lower skin flap 3 or 4 millimetres from its entrance and in a corresponding position. Four such sutures are inserted, 2 millimetres being allowed to intervene between each suture. The tarsus being deficient at the inner angle of the orbit the horizontal bite with the suture is taken through the soft tissue which replaces it as high up as possible.

The wound is washed and the sutures are tied and adjusted. A few additional touches of the knife may be required for the incision in the free border of the lid to make it gape and lie nicely. A few skin sutures for the edges of the wound are required.

The first dressing to be on the fourth or fifth day, when the sutures are removed; a light dressing spread with boracic ointment is continued for a few days, if required.

*2b. Anagnostakis' operation for the lower lid.* The entropion spatula is inserted beneath the lower lid and an incision  $\frac{1}{2}$  millimetre deep is made in its free border along its whole extent immediately behind the lashes.

An incision is then made through the skin 3 millimetres below the lashes extending the whole length of the lid, its upper edge is undermined as far as the roots of the lashes. The lower edge of the wound is undermined and retracted, the orbicularis is cleared away. If the cartilage is much thickened it is to be thinned by slicing it or cutting a horizontal wedge from its anterior surface, but this is not an essential part of the operation.



The sutures are then inserted of which there must be four or five. The needle is entered from above downwards through the upper edge of the skin in front of the lashes and of the cartilage. A horizontal bite of the fascia tarso-orbicularis is then taken well below the lower border of the cartilage. If the suture enters the conjunctival sac it is of no consequence. The needle is returned from below upwards through the upper edge of the skin wound, 3 or 4 millimetres from the other end of the suture. The other sutures are similarly inserted, not less than 2 millimetres intervening between each suture. The sutures are then tied, each pair in a single knot with a double turn, and adjusted so that the requisite degree of eversion of the lashes is produced. A few sutures are put in to bring the edges of the skin wound into correct apposition. A few touches with the knife may be required for the incision in the free border of the lid in order to make it lie nicely.

An antiseptic dressing is applied and removed on the fourth or fifth day when the sutures are also taken out. A light dressing spread with ointment is continued for a few days, if required.

3. *Van Millingen's graft.* This operation may be performed for any variety of entropion or trichiasis. It is especially suitable for cases in which an unsuccessful operation has been previously performed. The operation takes a longer time for its completion, and requires more experience than the other two operations. The operation may be performed on both the upper and the lower lids. In a sensitive patient a general anaesthetic is always necessary; otherwise the instillation of cocaine and a hypodermic injection of cocaine and adrenaline produce sufficient anaesthesia.

The entropion spatula is inserted and an incision is made as in the Anagnostakis operation along the whole free border of the lid immediately posterior to the lashes, and as close to them as possible, but without injuring them. It should be 2 millimetres or 3 millimetres deep.

The anterior half of the lid which includes all the lashes is now allowed to slide up towards the eyebrow, to the skin of which it is anchored by a few sutures. On the posterior half of the lid a horizontal strip of bare cartilage 2 or 3 millimetres wide is thus prepared to receive the graft.



The lower lip is now seized with forceps at each extremity by the assistant and everted. An injection of cocaine and adrenaline is made at the spot from which it is intended to remove the strip of membrane. If the patient is under general anaesthesia the injection consists of adrenaline only.

A grip with toothed forceps is taken towards the right side of the mouth and with a pair of narrow blunt-pointed scissors a strip of mucous membrane 25 millimetres long and 2 or 3 millimetres broad is cut. The strip of mucous membrane should always be somewhat narrower and shorter than the bed in the lid margin which is prepared to receive it. This is of the greatest importance; if it is not observed and a wide strip of mucous membrane is allowed to overhang the edges of the cartilaginous bed, the graft is much more likely to fail to adhere. The assistant sews up the wound of the lip with a blanket suture which may be of silk while the operator cleans from the raw surface of the membrane the adherent fat.

The graft is immediately laid in its lid-bed which has been covered with a gauze swab, without being washed with any antiseptic, with its raw surface downwards. It is carefully pressed into position with the moistened fingers of the operator. No sutures are required.

A dressing of sterilized gauze which has been spread with boracic acid ointment is carefully applied. It is not removed until the fourth day after the operation when the sutures are removed and a similar dressing is reapplied for a few days. The stitches in the lip are removed on the same or the previous day.

In cases where a mucous membrane graft is being used to repair large deficiencies of conjunctiva, due to shrinking or to injury, the strip cut from the lower lip may be much wider than has been above described. A great deal of shrinking occurs as is the case with all grafts.

5. *Electrolysis.* The greatest number of lashes which should be dealt with by electrolysis is three. If more than three, one of the operations previously described should be performed.

The current should be furnished by Leclanché cells, of which 6 are sufficient. A little under 1 milliampère is a good strength of current to employ; 1.5 to 2 milliampères give better results but

are more painful. It is essential that the needle should be attached to the negative pole. Deposits of iron from the needle, producing small black marks, can only occur if the positive pole has been employed instead of the negative. It cannot occur if an iridio-platinum needle be employed, but a steel needle has a better point and can be inserted along the hair follicle more easily. The needle should be sterilized by heat. Ten to twenty seconds are sufficient for the duration of the current, which should be broken at the positive pole, which is held in the patient's hand.

The lashes should be cleaned with perchloride of mercury solution 1 in 5000 before and after the operation.

OPERATIONS ON THE EXTERNAL CANTHUS. In some cases of entropion the palpebral fissure is so small that there is not sufficient room to allow of the performance of an operation for its relief. It is therefore necessary to enlarge the field of the operation.

This operation is also indicated in some cases of blepharospasm in children and in spastic entropion.

A speculum is inserted, one blade of a straight pair of strong scissors is thrust horizontally outwards into the conjunctival sac, the other blade being outside the skin, and the external canthus is divided.

An additional cut with smaller scissors must be made into the connective tissue strands which attach both lids to the edge of the orbit, so that each is freely movable and may readily be separated one from another.

If only a temporary widening of the palpebral fissure is desired, no further procedure is necessary as the wound soon closes. This operation, *canthotomy*, is all that is required in most cases of conjunctival oedema, the result of purulent inflammation.

If a permanent result is required, the conjunctiva must be undermined towards the cornea. Two or three sutures are then introduced to draw the conjunctiva up to the skin wound. This is the operation of *canthoplasty*.

If the conjunctiva is markedly contracted it may be necessary, though rarely, to increase the palpebral fissure by means of a flap of skin taken from the lower lid, *Kuhnt's operation*.

In Kuhnt's operation the canthus is divided as has been previously described. A tongue-like flap of skin is then cut from

the skin of the lower lid. The base of the flap which is to carry its blood supply lies beyond and below the external limit of the incision which has divided the canthus. The body of the flap slopes downwards and forwards from the divided canthus.

This tongue-like flap of skin is fixed into the gap produced by the division of the outer canthus with sutures.

Permanent disfigurement results from the operation, but in the cases in which it is likely to be used this is not a matter of much importance. In cases in which there is no spare skin in the lower lid, a piece of mucous membrane may be cut from the lower lip and grafted into the divided canthus.

**MACCALLAN'S OPERATION FOR ECTROPION OF THE LOWER LID IN TRACHOMA.** Ectropion of the lower lid is not unfrequently seen in Egypt in trachomatous patients. In these cases the tarsal cartilage is displaced so that its normal vertical axis comes to lie horizontally immediately underneath the conjunctiva. Between the attachment of the cartilage to the orbito-tarsal fascia and the globe the conjunctiva is usually found to be prominent, cicatrized and thickened. The fornix has almost disappeared in most cases.

The operation consists in the removal of the tarsus and in the formation of a fornix.

The lid spatula is placed below the eyelid to be operated on, the border of the lid is seized by the assistant with forceps and still further everted on the spatula.

(1) A horizontal incision is then made through the conjunctiva throughout the width of the eyelid about 5 or 6 millimetres from the margin of the lid, that is in the situation in which it is desired to make the new fornix: an incision is made at each extremity of the first incision to unite it with the inner and outer canthi stopping short 1 or 2 millimetres from the lid margin.

(2) The conjunctiva is then dissected from the subjacent fascia and cartilage as far as the margin of the eyelid.

(3) The cartilage is then removed with scissors together with as much redundant conjunctiva as is considered advisable.

(4) A threaded needle is entered from the skin surface five millimetres below the lashes through the tissue of the lid

and through the anterior edge of the conjunctiva. It is then passed forwards through the posterior edge of the conjunctiva coming out through the skin near to the point of entrance of the needle. Three such sutures are inserted and tied loosely. The result of this operation for the condition described is remarkably good. The stitches may be removed on the fourth or fifth day. It is of course important that the skin should be carefully sterilized with tincture of iodine and that non-absorbent material such as silk-worm-gut should be used for the sutures.

**DACRYOCYSTITIS.** This condition of inflammation of the mucous membrane of the lacrimal sac is common in Egypt. It may be due to an extension of the trachomatous process from the conjunctiva. Slight cases of chronic inflammation should be treated by careful syringing of the sac. When the sac is distended with secretion which re-forms after a course of expression and syringing it should be excised. Probes should never be used.

### 3. TREATMENT OF ACUTE CONJUNCTIVITIS.

**OPHTHALMIA NEONATORUM.** Previous to examining a case of ophthalmia neonatorum the surgeon should put on a pair of protective spectacles. When the infant's lids, which may be stuck together, are opened, there is frequently a spurt of dammed back discharge. It is to prevent this entering the surgeon's eye that protective spectacles should be worn by him as well as by those assisting him. Treatment is usually carried out once a day by the surgeon and during the rest of the day by the mother, but is insufficient for the needs of the case. If it is a serious one the surgeon should see the case twice a day, and a trained nurse should be constantly present.

The surgeon should irrigate the child's eyes with potassium permanganate solution 1 in 5000. The greatest care must be taken in the use of the irrigator or syringe, which should have its nozzle furnished with a short length of rubber tubing. If an abrasion of the cornea occurs, however slight, it may result in dangerous ulceration and perhaps loss of the eye.

Silver nitrate solution 1 per cent. in slight cases, 2 per cent. in the ordinary severe cases, should be applied to the everted lids



by the surgeon once a day or in severe cases twice a day. Solutions stronger than 2 per cent. should not be employed. The solid silver nitrate stick should never be used. The silver nitrate is applied by means of a tiny tampon of cotton wool on the end of a special glass rod.

Neither atropine nor eserine should be used as a routine treatment in ophthalmia neonatorum whether or not there be ulceration of the cornea. Atropine cannot prevent the occurrence of iritis. If the pupil is dilated by atropine, iritis is less liable to cause it to become fixed and blocked, but if the ulceration is slight there will be no iritis. If the ulceration is central and severe and perforation is imminent, the iris will be required to block the perforation and revitalize its edges by the formation of new vessels. It is therefore inadvisable to draw the iris away from the wound by dilating the pupil. In some cases however there is very severe pain which is relieved when the ciliary muscle is put at rest by this drug. There is no evidence that either atropine or eserine has any direct influence on the cornea.

If the ulcer is seen to be rapidly extending in area or if the edges become sloughy it may be lightly touched with the galvanocautery or with the actual cautery, but this procedure in my opinion does not often favourably influence the progress of the ulceration.

The eyes should never be tied up, nor should dressings hot or cold be applied to them.

If one eye only is affected, the other eye should be carefully cleaned and painted once a day with silver nitrate solution 1 per cent. and then tied up with a pad and bandage. This should be done by the surgeon before he commences the treatment of the affected eye; when this is completed the pad may be removed from the sound eye, or it may be retained in order to prevent infection.

If there is much oedema of the conjunctiva or if there is blepharophimosis (narrowing of the palpebral fissure), the external canthus must be divided (canthotomy) in order to allow more room for eversion of the lids during treatment.

The child's hands should be loosely tied together with a bandage in order to protect the eye from being rubbed.



A not infrequent complication of acute conjunctivitis in babies is spastic ectropion of the upper lid, or of both upper and lower lids, and is difficult to cure. This complication usually occurs as the acute inflammation is becoming chronic. It is caused by hyperplastic changes in the conjunctiva which destroy the natural tone of the lid, the redundancy of tissue actually forcing the lid margin outwards. Complete retroflexion of the upper eyelid may occur. The cornea is not usually exposed by the retroflexion owing to the increased volume of the conjunctiva.

When the inflammation subsides there is a tendency for the conjunctiva to become reduced to its normal dimensions and for the eyelid to regain its normal position. The treatment of spastic ectropion by a carefully adjusted pad and bandage, as the books say, is as invariably useless as by the insertion of Snellen's sutures. It is best treated by sewing the lids together with silk-worm-gut after dividing the outer canthus. If there is much discharge this should previously be treated for a day or two by painting with silver nitrate and constant bathing with solution of permanganate of potash, 1 in 5000. In neglected cases the above described methods of treating spastic ectropion are without avail. If there is a large ectropion of hyperplastic oedematous conjunctiva which resists other treatment, it may be successfully relieved by the performance of Heisrath's combined excision operation.

**GONOCOCCAL CONJUNCTIVITIS.** If the condition is monocular and expert nursing is available treatment should be preceded by the protection of the healthy eye from the infective discharge of its fellow by a Buller's shield. This shield consists of a watch glass fixed in a piece of indiarubber or adhesive plaster. It is placed over the healthy eye and is fastened to the skin of the forehead, bridge of the nose and cheek by means of strips of adhesive plaster. Small pieces of cotton wool moistened with collodion are used to finish off the sealing process on the nose near to the seat of infection. The outer side of the shield is left open for ventilation. There is often a slight discharge when ventilation under the shield is imperfect. A piece of indiarubber drainage tube inserted under the shield between the nose and the cheek improves this. The conjunctival condition requires careful watching and if necessary treatment with silver nitrate.

Where expert nursing is not available prophylaxis of the sound eye should be carried out by painting the lids once a day with silver nitrate solution 2 per cent. The strictest instructions must be given to the patient to avoid touching the unaffected eye with his fingers.

Treatment of the affected eye is carried out, after tying up the unaffected eye, by irrigation of the conjunctival sac with potassium permanganate solution 1 in 5000 twice a day, and painting the palpebral conjunctiva with silver nitrate solution 2 per cent. once a day or twice a day in very severe cases. Both these operations should be carried out by the surgeon himself. More frequent irrigation is advisable in severe cases, if practicable. Irrigation should not be carried out by hospital attendants except in the case of highly trained and experienced European nurses, owing to the danger of injury to the cornea with the nozzle of the irrigator. If the discharge is very tenacious it may be loosened with hydrogen peroxide solution (Merck's perhydrol is a concentrated form of this reagent), or with the aerated drink, Perrier water.

The patient should have by his side a bowl of permanganate of potash solution 1 in 5000, or of perchloride of mercury solution 1 in 5000, and a dish of cotton wool swabs with which to keep constantly washing away the discharge. The eyelids should be kept anointed with boracic ointment. During the night the patient should be awakened every four hours, or every two hours in severe cases, for swabbing the eye. If there is any suspicion of a mixed infection with the Morax-Axenfeld bacillus, and in all cases in which the diagnosis has not been made by bacteriological examination, drops should be used every four hours containing zinc sulphate  $\frac{1}{2}$  per cent.

If there is much swelling of the conjunctiva and oedema of the lids the outer canthus should be divided, taking care to sever the external attachment of the upper and lower tarsal cartilages. Scarification of the conjunctiva if greatly chemosed may also be carried out. On no account should the affected eye ever be closed with a pad and bandage. Neither hot nor cold dressings are of value.

Vaccine treatment has been stated to be of great value by

some who have tried it. It can only be looked upon as an adjuvant to the local treatment. The dosage is not yet decided with certainty.

If ulceration of the cornea occurs it must be carefully watched. If seen to be rapidly increasing in area or to become sloughy at the edges the galvano-cautery may be applied lightly and carefully but never except under the conditions I have described. Even when ulceration has proceeded so far that there appears to be no corneal tissue left, recovery sometimes results with sufficient clear cornea for the purpose of good vision. In such cases repair probably results from the cells which migrate from the pannus vessels.

In sloughy ulcers of the cornea, with perhaps a little stringy exudation in the anterior chamber, the division of the base of the ulcer from within outwards with a Graefe knife (Saemisch's section) is of great value; it allows revitalization of the edges of the ulcer by prolapse of iris. Ulceration of the cornea sometimes occurs in which the whole thickness of the cornea becomes destroyed except Descemet's membrane, which can be seen slightly bulging in the floor of the ulcer (keratocele). Where a definite loss of tissue has occurred, repair cannot take place without adhesion of the iris to the wound, but while Descemet's membrane intervenes, this cannot occur. The treatment in such cases is to perform an iridectomy and then as soon as the eye has quieted down to destroy Descemet's membrane with the cautery and to allow the iris to prolapse into the wound. If the ulcer is situated centrally the iris must be pulled into the gap with forceps, even though this causes iridodialysis.

Atropine should not be given as a routine for reasons which have been previously discussed under the heading of ophthalmia neonatorum, it may however be used to put the ciliary muscle at rest when the drug can no longer influence the iris. The use of eserine may contract the pupil and allow the iris to block up an ulcer and revitalize its edges. This however is not usually necessary, as the pupil contracts when perforation and loss of aqueous humour occur, unless posterior synechiae have formed.

If panophthalmitis supervenes (which is a rare occurrence) evisceration of the globe is indicated, the sclera being excised

later when all inflammation has subsided. This is not because excision of an eye with panophthalmitis is a dangerous procedure in skilful hands, but because the friability of the conjunctiva frequently leads to considerable destruction of that membrane. The result may be some contraction of the socket and difficulty in wearing a satisfactory artificial eye.

Destruction of the cornea by ulceration, if considerable, is accompanied by escape of the lens and vitreous, and results in a shrunken globe.

If there is considerable pain the patient must be kept under the influence of morphine administered hypodermically; cocaine should never be dropped into the conjunctival sac for the purpose of diminishing its sensibility, on account of its deleterious effect on the cornea.

The various organic compounds of silver, argyrol, protargol, etc., are used by some experienced surgeons in gonococcal conjunctivitis. If for any reason it is impossible for the surgeon himself to apply silver nitrate he may order argyrol solution 25 per cent., freshly made with cold water, to be used every two hours. It cannot possibly do any harm and is soothing in its effect. Protargol 10 per cent. may be used similarly. Argyrol and protargol may be ordered in addition to the silver treatment.

Staphyloma of the cornea in a blind eye, the result of an acute conjunctivitis, is sometimes very disfiguring. The only operation which can be recommended is excision of the globe. The highly unsurgical operation of staphylectomy is however performed by some practitioners in Egypt, and results not infrequently in damage to the sound eye from sympathetic ophthalmia. That such a result is believed not to occur by those surgeons who practise this operation does not speak well either of their observation or of their power of retaining the confidence of their patients; the presumption being that when sympathetic irritation of the sound eye occurs the patient seeks the help of another surgeon. There is of course no objection to the performance of staphylectomy if the other eye is also blind.

Traumatic sympathetic ophthalmia is not common in Egypt, as dangerous trades are few in number. But this condition is

not unfrequently seen to result from ulceration of the cornea with perforation and prolapse of the iris.

The tattooing of the cornea with indian-ink to conceal large leucomata is not a safe operation unless the leucomata are non-adherent, for the same reason that staphylectomy is dangerous. It is performed by stabbing the cornea obliquely with a needle and then rubbing in the ink, some of the suspended particles of which remain permanently in the track of the needle. To tattoo a leucoma completely the operation should be spread over several sittings, in order to prevent the inflammation caused by the insertion of the foreign particles from becoming severe.

The treatment of the other varieties of conjunctivitis does not differ from that above described. In diplobacillary conjunctivitis however zinc drops are a specific in ordinary cases.



## PART IV.

### 1. DIFFERENTIAL DIAGNOSIS.

OCCASIONALLY trachoma is differentiated with difficulty from certain other conditions. These are :

(1) Chronic conjunctivitis. Trachoma IIc, or *florid trachoma*, may resemble very closely chronic gonococcal conjunctivitis. This is especially the case in children. The condition cannot be stated to be trachomatous unless one of the following pathognomonic signs is present :

(a) Follicles. These may be seen in the tumefied conjunctiva, or their gelatinous contents may be squeezed out with the fingers and thumb from the everted lid.

(b) Pannus. Trachomatous pannus must be distinguished from the vascularization which occurs in corneal ulceration and interstitial keratitis (see chronic gonococcal conjunctivitis).

(c) Punctate depressions at the periphery of the cornea resulting from the cicatrization of corneal follicles.

(d) Cicatrization of the conjunctiva of the upper lid typical of trachoma.

No case should be diagnosed as trachoma unless one of these clinical signs is present, even though the surgeon considers it probable that the conjunctiva is already infected with trachoma.

(2) Follicular conjunctivitis. This is rarely seen in Egypt except among European children. In the Egyptian kuttabs, or infant schools, it is occasionally diagnosed provisionally by the ophthalmic surgeon, but at the next inspection, after six months or perhaps a year, the appearance is generally characteristic of trachoma. This does not necessarily mean that the first diagnosis was incorrect, for the virus of trachoma is ever present,

and its contagion may have grafted itself on to the follicular conjunctivitis.

The clinical appearance of follicular conjunctivitis consists in the formation of follicles on the conjunctiva of the lower eyelid. European authorities are agreed that the follicles are situated in the fornix. In Egypt however the follicles appear in a row just inside the lower lid. They do not differ from the follicles of trachoma I in appearance except in their grouping, which is in one or more rows.

The diagnosis of follicular conjunctivitis can only be verified by the cure of the condition, and the disappearance of the follicles without cicatrization and without the development of pannus.

The treatment of the condition is by painting with silver nitrate 2 per cent. if there is a discharge. When the discharge ceases no treatment is of avail, attention to the general health only being required. The histology of the follicle differs considerably from that of a trachomatous follicle. It often lies more superficially and abuts directly against the epithelium, which shows degenerative mucoid changes. A well-defined endothelial capsule can frequently be demonstrated, together with a delicate stroma. The cellular contents are composed almost entirely of lymphoid cells, both large and small, becoming paler in their staining reactions towards the centre of the follicle. Plasma cells are present in considerable numbers. Minute "endo-follicles" not infrequently can be demonstrated.

(3) Spring catarrh. Two types of spring catarrh exist: the palpebral form and the bulbar form; the former is common in Egypt, the later is rare; it is nearly always accompanied by trachoma.

In a typical palpebral case the conjunctiva of the tarsus, especially the upper tarsus, is covered with papillae, which are broad and flattened, so as to make the conjunctiva appear like a pavement of cobble-stones. Over the whole lies a delicate, bluish-white film, as if a thin layer of milk had been poured over the conjunctiva.

In a typical bulbar case there is a thickening of the conjunctiva at the limbus, under the form of brownish uneven hard

nodules of gelatinous appearance; these extend partly into the clear cornea but still further in the opposite direction into the conjunctiva. In Europe the two forms usually co-exist. Educated people are able to give a history of annual attacks in the spring of each year. The signs of the spring catarrh disappear with cure of the disease without leaving any traces of their former existence.

The treatment by scraping or the application of drugs makes the condition worse. When the sharp spoon is used it runs over the lid without making any impression on it, as if one tried to scrape the roughly pitched bank of a canal. Many cases have been reported in which treatment by radium has effected a complete cure. Cases of long standing may be treated by the removal of tarsus and conjunctiva by Heisrath's combined excision operation. Uncomplicated cases are said to improve under an occluding bandage; this treatment is not applicable in Egypt where spring catarrh is always complicated by trachoma.

The histology of the papillae resembles that of fibromata, there is a thickened epithelium lying on fibrous tissue. The histology of the conjunctival thickening of the limbus is the same, but the fibrous tissue formation is less. The tissue and the discharge contain large numbers of eosinophile cells.

In Egypt the palpebral type of spring catarrh is almost always accompanied by trachoma, and this clinical entity, which for convenience I have called trachoma IIb'', cannot in many cases be distinguished from the papillary type of trachoma, trachoma IIb', except by finding an excess of eosinophile cells in the spring catarrh variety. However, the papillae in trachoma IIb' are typically softer, redder and less sessile than in trachoma IIb''.

(4) Parinaud's conjunctivitis, though as rarely seen in Egypt as elsewhere, may easily be mistaken for trachoma with acute onset.

This disease is a monocular inflammation of the conjunctiva with formation of follicles, accompanied by swelling of the preauricular gland and sometimes by fever.

(5) Atropine irritation. Formation of follicles occurs in certain individuals who have an idiosyncrasy for atropine. The condition is cured by stopping the administration of the drug.

## 2. PROGNOSIS.

Boldt has said that every surgeon of experience in trachomatous countries has observed isolated cases in which spontaneous cicatrization has resulted without medical aid, and without corneal or other complications. He might also have added that pannus and entropion sometimes develop in cases which are in receipt of skilled treatment and that it almost seems sometimes that the condition is aggravated by that treatment.

These however are exceptional occurrences; the treatment that I have outlined in a previous chapter will lead to a cure if it be carried out intelligently, and if the case is seen early enough. In those cases in which treatment is commenced before any marked vascularization of the cornea has occurred, an ultimate cure under favourable external conditions within a limited time can be promised. These periods have already been indicated. But cure must be followed by the permanent use of prophylactic treatment such as by the daily instillation of a suitable collyrium. When gross anatomical changes have already occurred, such as vascularization of the cornea and incurving of the lid, it is useless to expect to obtain complete restoration to the normal. This should be remembered when the cry is raised that trachoma is incurable.

The prognosis of untreated cases need not delay us here. It is impossible to express any idea at the onset of a trachomatous infection how long it will last, or to which of the usual complications it will give rise; these depend partly on the patient's defensive mechanism, partly on how much he is exposed to the bactericidal action of the open air and sun, partly on chance infections with the gonococcus and other organisms.

## 3. THE INFLUENCE OF TRACHOMA ON OPHTHALMIC OPERATIONS.

Trachoma existing alone and uncomplicated by conjunctivitis of microbial origin is not a bar to operation, whether extraocular or intraocular.

It is however certain that the crypts and crevices which exist between the follicles or papillae in trachoma II contain more organisms capable of exciting intraocular inflammation than does the smooth surface of the normal conjunctiva. Therefore the performance of an operation such as that for the removal of cataract should be postponed until by operation and treatment trachoma has been brought to stage III. The operation for trichiasis and entropion interferes for a short time at any rate with the facility with which the lids can be everted. If it is intended to carry out any treatment for trachoma, this should be done before the trichiasis operation, unless the malposition of the lids calls for immediate remedy. Reasons for immediate operation would be corneal ulceration or severe pain.

The necrotic foci of *post-trachomatous-degeneration* are usually septic and should invariably be evacuated previous to the performance of any other operation. In a case of entropion in which the cornea is ulcerated and in which the conjunctiva shows exuberant follicles or papillae it is better practice to perform Heistrath's operation than an operation which merely corrects the entropion.

The performance of iridectomy in cases of corneal ulceration with prolapse of the iris is frequently indicated as a prophylactic measure against glaucoma previous to the cessation of suppuration. The operation may be performed without fear of the occurrence of intraocular inflammation in gonococcal infections, but with less certainty of success in the other conjunctival infections.

No intraocular operation should be performed under any conditions while one or more eyelashes rub on the globe.

#### 4. PROPHYLAXIS.

Prophylaxis against trachoma and contagious ophthalmias in a country like Egypt, where such a large proportion of the population is infected with eye diseases, must be a difficult matter.

In Egypt what measures should one adopt to prevent the infection of an individual from birth onwards?



If the mother is in a contagious condition, nothing will prevent the child becoming infected. But the trachomatous mother should have been treated before her child was born, and if not cured at any rate rendered non-infective. If the stage trachoma III had been reached, and a little simple treatment by the patient herself continued during her confinement, a condition of non-infectivity would have been produced. But even given a healthy mother trachoma cannot be prevented from attacking the child, unless the other members of the family, who come in contact with the child, are also rendered non-infective. It is therefore advisable that all the members of the family, including servants, should receive efficient treatment.

Cleanliness is the greatest safeguard against infection and should be observed from the day of birth onwards. It is noteworthy that no European oculist in Egypt has become infected with trachoma during the last twenty years, also that the British Army of Occupation has practically no cases of trachoma in its ranks.

It must be remembered that all discharges from a trachomatous eye, including tears, are infective. Trachoma IIa is the most violently contagious stage, while trachoma IV and later stages of trachoma III are not contagious.

The prophylaxis of ophthalmia neonatorum may be carried out with almost complete but not absolute certainty. As soon as the child's head is born, and if possible before the eyes are opened, the eyelids should be carefully cleaned and a single drop of 1 per cent. solution of silver nitrate should be put between the eyelids of each eye.

Wherever a woman in labour has a vaginal discharge the vagina should be carefully douched with perchloride of mercury solution 1 in 5000 or with permanganate of potash solution 1 in 5000. If this is impossible owing to deficient apparatus and attendance, at least the external genitals should be carefully cleaned with soap and water and dried with a clean towel.

Simple directions which may be given to poor patients for prophylaxis against ophthalmia neonatorum are as follows:

Previous to birth a small packet of cotton wool should be purchased at a chemist's. As soon as the child is born and the

cord tied the midwife should wash her hands and then, dipping a piece of cotton wool in some boiled water, should wipe away from the child's eyes all meconium and discharge. Every day for seven days after birth the same cleansing process should be repeated. After this period washing the face twice a day in water is all that is required. If the face is kept clean there will be fewer flies to drive away from the child.

It is dangerous for a healthy person to use the same bed or the same pillow as another person who has a discharge from the eyes.

Every person in a house should have his or her own towel for drying on after ablutions, and his or her own handkerchief (a counsel of perfection as regards the fellahin).

The application of kohl to the eyelids rarely does any harm if it is clean and if the marwid (instrument with which it is applied) is also clean. But when the same powder and marwid are used for many people they become an important vehicle of contagion.

Children should not be allowed to play with other children who have a discharge from the eyes, nor to play with dust. When the time comes for the child to go to a kuttab, the institution should be carefully chosen as being sanitary, with proper water supply, convenience for washing the hands, and with sufficient air space. If this is not done it is almost impossible that the child can escape infection. Particular instructions should be given to the child never to dry his hands or face on a towel used by others at the kuttab.

Both at school and throughout life care should be taken to wash the face and especially the eyelids twice a day with soap and water; in this way dust and other infective material will be removed. The hands should be washed as often as is practicable for the same reason. The eyelids should never be rubbed with hands; a clean handkerchief should be used if it is necessary to wipe them.

If in spite of all these precautions the eyes become infected, the services of an ophthalmic surgeon should be sought immediately.

Ophthalmic surgeons when treating patients with a conjunctival discharge should invariably wear protective spectacles.

If a drop of secretion or of aqueous humour nevertheless gets access to the eye, it should be washed out immediately with boracic lotion or tap water, and the conjunctiva should be carefully painted with silver nitrate solution 2 per cent. If there is any discharge on the following day the silver nitrate should be repeated.

### 5. CAUSES OF BLINDNESS IN EGYPT.

My definition of blindness is inability to count fingers at a distance of one metre. It may be caused either by trachoma itself or by the sequelae of the disease. It is however in conjunction with a superimposed acute conjunctivitis, gonococcal, Morax-Axenfeld, etc., that destruction of vision by corneal ulceration usually occurs in Egypt.

Blindness may be caused by simple trachoma in one of several ways :

- (a) By the formation of thick fleshy pannus.
- (b) By giving way of the cornea under the normal ocular tension and formation of keratoconus or anterior staphyloma.
- (c) By destruction of Bowman's membrane by pannus and the subsequent opacity of the cornea.

Trachomatous ulceration of the cornea alone rarely causes blindness either by resulting opacity or by perforation and its result. The sequelae of trachoma which may cause blindness are trichiasis, entropion and xerosis. The corneal epithelium is injured by the continual rubbing of the lashes and becomes cicatrized and opaque, or ulceration may occur leading to the same result. The corneal opacity which results from xerosis is a frequent cause of blindness in Egypt owing to the large number of cases of lagophthalmos which result from badly performed trichiasis operations by charlatans.

Blindness, the result of any form of purulent ophthalmia producing ulceration of the cornea, may be caused in the following ways :

- (a) By cicatrization leaving a dense central leucoma.
- (b) By perforation of the cornea leading to adhesion of the iris to the base of the ulcer, the formation of an adherent leucoma, and subsequently to secondary glaucoma.

(c) By destruction of the cornea allowing escape of the intra-ocular contents and resulting shrinking of the globe.

(d) By destruction of the cornea, followed by infection of the vitreous, formation of an abscess (panophthalmitis), extrusion of the contents and subsequent shrinking of the globe. In some cases the abscess becomes inspissated and calcifies without being extruded. In either case the globe shrinks.

(e) By the occurrence of iritis which leads to seclusion of the pupil, with blocking of the pupil by inflammatory exudation.

I have notes of 23,001 blind eyes seen in Egypt during the last five years, the causes of which were diagnosed as follows :

A. Congenital . . . . . 5

B. Acquired :

1. Conjunctivitis resulting in :

(a) Total corneal opacity . . . .	4167
(b) Shrunken globe . . . .	4817
(c) Secondary glaucoma . . . .	3425
(d) Various . . . .	3644

2. Fundus diseases :

(a) Optic atrophy . . . .	345
(b) Retinitis Pigmentosa . . . .	92
(c) Various . . . .	562

3. Primary glaucoma :

(a) Monocular . . . .	1393
(b) Binocular . . . .	1813

4. Cataract . . . . . 809

5. Injury . . . . . 94

6. Operation by quack doctors . . . . 118

7. Infectious disease . . . . . 36

8. Endogenous iritis . . . . . 356

9. Various . . . . . 1325

Total 23,001

From these statistics it is seen that 69·7 per cent. of all the cases of blindness are the result of trachoma and acute conjunctivitis. Gonococcal conjunctivitis is probably the most frequent cause of blindness in Egypt; according to Meyerhof's recent estimate gonococcal conjunctivitis is responsible for at least 40 per cent. of the total cases of blindness in Egypt.

The amount of blindness in Egypt may be mentioned in this connection. The census for 1907 showed that more than half a million persons were blind in one or both eyes, or  $4\frac{1}{2}$  per cent. of the entire population. But the Director-General of the Census in a note states that this is probably considerably too low owing to the reticence which naturally exists in this country, as in Europe, to declare personal infirmities. Perhaps a truer estimate of the amount of blindness would be the census figures doubled, which would make a million people in Egypt blind in one or both eyes, or 9 per cent. of the population. This is rendered more probable by a consideration of the statistics of blindness at the Egyptian Ophthalmic Hospitals for 1912, where it is shown that 15.2 per cent. of those applying for treatment were blind in one or both eyes.

### *Blindness*

Year	Total No. of Patients examined	One eye		Both eyes		One eye and both eyes	
		No.	Per cent.	No.	Per cent.	No.	Per cent.
1906	40,103	1297	3.2	663	1.6	1960	4.9
1907	24,416	1450	5.9	697	2.8	2147	8.7
1908	19,614	1189	6.0	852	4.3	2041	10.4
1909	22,373	2116	9.4	1385	6.1	3501	15.6
1910	25,506	2438	9.5	2010	7.8	4448	17.4
1911	31,274	3196	10.2	2811	8.9	6007	19.2
1912	43,668	4115	9.4	2824	6.4	6939	15.8
Total	206,954	15,801	8.7	11,242	6.5	27,043	15.2

## 6. STATISTICS.

### (a) *Percentage of trachoma in Egypt.*

An estimate of the number of people infected with trachoma in Egypt may be made from a consideration of the statistics at certain infant and primary schools which are either maintained or subsidized by the government and over which I have ophthalmic control.



*Tanta Infant Schools (Kuttabbs) 1912.*

No. of pupils examined	...	...	...	...	2270
Healthy	...	...	...	...	59
Conjunctivitis not definitely diagnosed	...				138
Trachoma	...	...	...	...	2073
Percentage of trachoma	...	...	...		91.32

It is also of interest to note that 65 pupils were blind in one eye and 21 blind in both eyes.

*Assiut Infant Schools (Kuttabbs) 1912.*

No. of pupils examined	...	...	...	...	969
Healthy	...	...	...	...	22
Trachoma	...	...	...	...	947
Percentage of Trachoma	...	...	...		97.5

Here 34 pupils were blind in one eye.

It is thus seen that the town population, at the age when children go to infant schools, is infected with trachoma to the extent of more than 90 per cent. The higher percentage at Assiut probably indicates that the surgeon who made the clinical examination on which the statistics were based had more time at his disposal for the detailed study of each pupil, i.e. for focal examination of the cornea for pannus in doubtful cases.

*Tanta Primary School, 1912.*

No. of pupils examined	...	...	...	...	969
Healthy	...	...	...	...	17
Trachoma	...	...	...	...	952
Percentage of trachoma	...	...	...		95.3

At this school the amount of trachoma has varied from 95 to 96 per cent. during the last five years, and this in my opinion indicates the average percentage of the population infected with the disease.

(b) *Effect of treatment.*

A system of ophthalmic treatment was instituted by me at Tanta Primary School in 1907, and was described in the *Ophthalmoscope*, 1908. The results of treatment are as follows:

	Previous to commencement of treatment, 1907		After treatment, 1912	
	No.	Per cent.	No.	Per cent.
Healthy .....	21	4·3	17	4·64
Trachoma I ...	78	16	—	—
"    II ...	211	43·5	1	·27
"    III...	165	34	227	62·02
"    IV...	10	2	121	33·06

The value of the treatment is shown by the reduction of *trachoma II*, the most infective stage of the disease, from 43·5 to less than 1 per cent.

(c) *Effect of trachoma on the cornea.*

At Tanta Primary School in 1912 the corneal condition of pupils was as follows:

Both corneae clear	...	...	...	194
One cornea clear the other with gross opacity				64
Both corneae with gross opacity	...	...		108

It is thus seen that in a community which is heavily trachomatized and in which acute ophthalmia is rife the cornea escapes permanent opacity in little more than half the members.

(d) *Effect of trachoma on the vision.*

A comparison of the visual acuity among the pupils at Tanta School in 1912, with that of Leith School children 1906, and with that of certain London County Council School children 1906 (in the two latter series of statistics no correction of ametropia was made), is here given:

	Tanta		Leith		L. C. C.	
	No.	%	No.	%	No.	%
Pupils with normal vision 6/6 in each eye (correction of ametropia up to + or -6 D. allowed)	69	18·8	523	74·50	24099	75·2
Pupils with fair vision 6/9 or 6/12 in one eye and 6/6, 6/9 or 6/12 in the other. (Correc- tion of ametropia up to + or -6 D. allowed).	127	34·7	51	7·26	5311	16·5
Pupils with bad vision 6/18) or inferior degrees in one or both eyes	170	46·4	128	18·23	2603	8·1

This comparison is very striking. In England and Scotland the majority of the pupils have good vision, while in Egypt the majority have bad vision.

*(e) Causes of subnormal vision among 366 pupils at Tanta Primary School.*

- |   |     |     |     |     |
|---|-----|-----|-----|-----|
| 1. Corneal opacity or Anophthalmos*                 | ... | ... | ... | 178 |
| 2. Ametropia :                                      |     |     |     |     |
| (a) Hypermet. (including hypermetropic astigmatism) |     |     |     | 48  |
| (b) Myopia (including myopic and mixed astigmatism) |     |     |     | 51  |
| 3. Other cases :                                    |     |     |     |     |
| (a) Iris, ciliary body and vitreous, diseases of    |     |     | ... | 1   |
| (b) Lens, opacity of                                | ... | ... | ... | 1   |
| (c) Fundus, disease of                              | ... | ... | ... | 2   |
| (d) Central nervous system disease                  | ... | ... | ... | —   |
| 4. Congenital                                       | ... | ... | ... | 1   |

It is seen that the great majority of the cases of subnormal vision are caused by corneal opacity. Investigations are now being made with reference to the production of myopia by corneal opacity; as yet I have no evidence of this.

\* There were 6 cases of anophthalmos.

*(f) Clinical material.*

The clinical material on which this monograph is based is here shown; a comparison with the amount dealt with in 1904 is included:

	1904	1912
Hospitals in existence : (1) Travelling	1	4
(2) Permanent	—	4
New patients treated ... ..	2,954	28,029
Total attendance of out-patients ...	15,039	341,211
Operations performed ... ..	1,282	21,315
Details :		
Patients examined ... ..		43,668
Patients regularly treated ... ..		28,029
Incurable cases ... ..		7,200
Blind in one eye ... ..		4,115
Blind in both eyes ... ..		2,824
Trichiasis cases examined ... ..		13,176
„ „ operated on and cured		6,942
New patients treated per age :		
Under 1 year ... ..		1,495
From 1 to 5 years ... ..		3,317
„ 6 „ 10 „ ... ..		3,210
„ 11 „ 15 „ ... ..		3,056
„ 16 „ 20 „ ... ..		2,588
„ 21 „ 40 „ ... ..		8,167
41 and over ... ..		6,196

At the end of the year 1913 the number of hospitals in existence will be:

Travelling	...	...	6
Permanent	...	...	8

The ophthalmic hospitals system is gradually being extended until in the future it is hoped to have in each province not less than one permanent hospital and one travelling hospital—in all 28.

## 7. LITERATURE.

1. Axenfeld. *Bacteriology of the Eye* (trans. Macnab, London).
2. Boldt. *Trachoma* (trans. Parsons and Coats, London).
3. Butler, T. Harrison. *R. L. O. H. Rep.*, 1907.
4. Calderaro. *Archiv f. Augenheilkunde*, 1911.
5. Cazaux. *Archives d'Ophth.*, 1912.
6. Collins and Mayo. *Pyle's System of Ophthalmic Practice*.
7. Cohen. *Archives of Ophth.*, 1913.
8. De Wecker. *Annales d'Oculistique*, 1900.
9. Darier. *Leçons de thérapeutique oculaire*. Paris, 1911.
10. Eloui. *International Medical Congress*, 1902.
11. Fuchs. *Ophthalmology*, (trans. Duane).
12. Goldzieher. *International Congress of Medicine*, 1909.
13. Greef. *Ophthalmoscope*, 1910—1911.
14. Gurley and Chase. *N. Y. Research Lab.*, pub. 1911.
15. Herbert. *T. O. S.*, 1899—1902.
16. Hourmouziades. *De la conjonctivité granuleuse*. Paris, 1902.
17. Harman, Bishop. *The conjunctiva in health and disease*, 1905.
18. Hirschberg. *Aegypten*. Leipzig, 1890. Quoted.
19. Kartulis. *Centralblatt f. Bakt.*, 1887. Quoted.
20. Knapp. *Archives of Ophth.*, 1904.
21. Kuhnt. *Zeitschrift für Augenheilkunde*, 1899.
22. Kuhnt. *Klinisches Jahrbuch*, 1897.
23. Lawson. *R. L. O. H. Rep.*, 1897.
24. Lakah and Khouri. *Annales d'Oculistique*, 1902.
25. Lindner. *Archives of Ophth.*, 1912.
26. Meller. *Ophthalmic Surgery*, trans.
27. Meyerhof. *Ann. d'Ocul.*, 1906—1911. Also private communication 1911.
28. MacCallan. *Ophthalmoscope*, 1906—1911.  
*International Congress of Medicine*. Budapesth, 1909.  
*British Medical Journal*, 1911.  
*Ophthalmic Record*, 1910.  
*Archives d'Ophthalmologie*, 1911.
29. McKee. *Ophthalmic Record*, 1911.
30. Martin. *Brit. Med. Journal*, 1913.
31. Morax. *Maladies de la conjonctive*. *Encyc. franç. d'Ophth.*, 1905.
32. Müller. *Heidelberg Ophth. Gesellsch.*, 1904.
33. Nicolle, Blaizol, Cuénod. *Annales d'Ocul.*, 1912.



34. Osborne. *International Medical Congress*. Cairo, 1902.
35. Parsons. *Pathology of the Eye*, 1904.
36. Prowazek. *Ophthalmoscope*, 1910.
37. Peretz. *Ann. d'Ocul.*, 1911.
38. Peretz et Truc. *Rev. gén. d'Ophth.*, 1908.
39. Solomon. *Trans. Amer. Micro. Soc.*, 1911.
40. Stephenson, Sydney. *Report to Local Government Board*. London, 1897.  
*Ophthalmia Neonatorum*, 1907.  
*T. O. S.*, 1892.
41. Sulzer. *Ann. d'Ocul.*, 1909.
42. Treacher Collins. *R. L. O. H. Rep.*, 1910.
43. Truc and Peretz. *Rev. gén. d'Ophth.*, 1908.

# INDEX

- Adrenaline, 37, 40, 44, 45
- Adrenaline hydrochloride, 33, 40
- Alexandrian Library, references to trachoma, 1
- Amblyopia, 14
- Amyloid disease, 27
- Anaesthetics, 33
  - See* Cocaine, Morphine
- Anagnostakis' incision, 42
- Anagnostakis' operation,
  - for upper lid, 42
  - for lower lid, 43
- Aniline dyes, 19, 23
- Anthropoid apes, experimental trachoma in, 28
- Argyrol, 31, 32, 53
- Arlt's line, 24
- Arthritis, gonorrhoeal, 14
- Atropine, 49, 52
- Atropine irritation, 57
  
- B. coli communis*, 21
- B. pyocyaneus*, 21
- Blepharophimosis, 49
- Blepharospasm, 46
- Blindness,
  - definition of, 62
  - in Egypt, causes of, 13, 14, 62, 63
  - „ „ statistics of, 64
  - at night. *See* Night-blindness
- Boracic ointment, 33, 38, 43, 45, 51
- Bowman's membrane, 10, 11, 26, 35, 62
- British Army in Egypt immune from trachoma, 60
- Buller's shield, 50
- Buphthalmos, 14
  
- Canthoplasty, 46
- Canthotomy, 46, 49
- Canthus, outer division of, 50, 51
- Cant's cuts, 42
- Carbon dioxide snow treatment, 32
- Caruncle, 18, 27
- Cataract, 13, 63
- Catarrh, spring, 23, 56, 57
- Cell inclusions of Prowazek, 28
- Census, Egypt, 1907, statistics of blindness in, 64
- Cicatrization in trachoma,
  - commencing, 9
  - advanced and complete, 10, 36
  - process of, 24
  - danger of excessive, 34
  - increased by carbon dioxide snow treatment, 32
  - pathognomic, 55
  - spontaneous, 58
- Cleanliness,
  - absence in Egypt of, 4
  - protection against trachoma, 60
- Cocaine, 33, 37, 44, 45, 53
- Cocaine hydrochloride, 40
- Conjunctiva,
  - chemosis of, 12, 15, 51
  - degeneration of, 27
  - excision of, 37
  - oedema of, 12, 46, 49
  - scarification of, 51
  - scarring of, 14
  - scraping of, 57
  - tumefaction of, 8
- Conjunctivitis,
  - acute,
    - precedes trachoma, 4
    - epidemic, 16
    - etiology of, 18, 19
- Cohen's, 29
- diphtheritic, 20
- diplobacillary, 18
- due to various organisms, 21
- gonococcal,
  - acute, 15, 17
  - sub-acute, 15
  - chronic, 16
  - bacteriology of, 17
  - complicating trachoma, 5, 8, 11
- Koch-Weeks, 18
- membranous, 20
- Parinaud's, 57

- Connective tissue formation. *See* Cicatrization
- Copper sulphate stick, 31, 33, 36
- Cornea,  
     in keratitis, 6  
     in trachoma, 66  
     destruction of, 52, 63  
     facets of, 19  
     necrosis of, 15  
     opaque, 11, 13, 35, 62  
     perforation of, 12, 62  
     scarring of, 35  
     tattooing of, 54  
     trachoma of. *See* Pannus  
     trephining of, 14  
     ulceration of, 6, 11, 12, 13, 15, 16, 18, 34, 52, 53, 62
- Cul-de-sac, 6
- Dacryocystitis, 48
- Degeneration,  
     colloid, 27  
     post-trachomatous, 23, 36
- Descemet's membrane, 52
- Diagnosis of Trachoma. *See* Trachoma
- Diphtheritic conjunctivitis. *See* Conjunctivitis
- Diphtheria antitoxin treatment, 20
- Diplobacillus. *See* Morax-Axenfeld's bacillus
- Discharge, ophthalmic, 4, 6, 7, 8, 12, 15, 18, 31, 34
- Dust and infection, 3, 4, 30, 61
- Ebers' papyrus, 1
- Ectropion, 8, 23
- Egyptian Ophthalmic Hospitals,  
     classification of trachoma in, 5  
     clinical statistics of, 68  
     proposed increase of, 68  
     statistics of blindness in, 64
- Electrolysis, for eyelashes, 45
- Entropion,  
     in trachoma, 20, 24, 34  
     causes blindness, 32  
     spastic, 8, 23  
     treatment for, 37, 40-7
- Eosinophile cells, 8, 57
- Eserine, 49
- Eyelashes,  
     proliferation of, 25  
     cutting of, 40  
     electrolysis for, 45
- Eyelids  
     in trachoma, 10  
     in gonococcal conjunctivitis, 15  
     *See* Entropion, Trichiasis
- Flies and infection, 4, 61
- Follicles,  
     in trachoma, 6, 7, 22, 23, 34, 55  
     in conjunctivitis, 16, 57  
     absorption of, 30  
     mechanical rupture of, 32
- Fornix, trachoma commencing on, 56
- Galvano-cautery, 49, 52
- Glasses, protective,  
     for patient, 39  
     for doctor, 48, 61
- Gonococcus,  
     causes acute conjunctivitis, 4  
     chronic conjunctivitis, 5  
     resistance of, 17  
     *See* Conjunctivitis, gonococcal
- Graddy's forceps, 33
- Graefe knife, 52
- Graft operations, 27, 37, 45  
     *See* Van Millingen's Graft
- Gram's staining, 18, 19, 21
- Granulation. *See* Follicles
- Haematoxylin, 23
- Heisrath's operation, 10, 27, 31, 32, 36, 50, 59  
     for upper lid, 37  
     for lower lid, 38
- Hippocrates, 1
- Hydrogen peroxide solution, 51
- Infant Schools, Egyptian,  
     trachoma in, 61, 65  
     conjunctivitis in, 55
- Infection with trachoma, modes of, 4, 60, 61
- Infiltration, 16, 23, 26
- Influenza bacillus (Pfeiffer's), 21
- Investigators of eye-disease in Egypt, 3

- Iodine, 48
- Iridectomy, 14, 52, 59
- Iris,
  - adhesion of, 13
  - prolapse of, 13
- Iritis, 49, 63
- Irrigation of eye, 48, 51
- Jequiritol, 35
- Keratitis, 6
- Keratome, 14
- Klebs-Löffler bacillus, 20
- Koch-Weeks bacillus, 4, 11, 17-19
- Kohl, infection conveyed by, 61
- Kuhnt's operation, 39, 46
- Kuttab. *See* Infant Schools, Egyptian
- Lagophthalmos, 2, 25
- Larrey, 2
- Leucocytosis, 34
- Leucoma, 13, 54
- Levator palpebrae superioris muscle, 39
- Levator tendon, 38
- Lindner's "initial bodies," 28
- MacCallan's entropion spatula, 40 (*note*)
- MacCallan's operation of ectropion, 47
- Mast cells, 23
- Merck's perhydrol, 51
- Mercury,
  - perchloride of, 21, 32, 33, 36, 46, 60
  - pyoctanate of, 32
- Methylene blue, 23
- Meyerhof, 3, 4, 8, 18, 23
- Monkeys, experimental ophthalmia in, 29
- Morax-Axenfeld's bacillus,
  - causes acute conjunctivitis, 4, 11, 18
  - corneal ulceration, 19
  - blindness, 62
  - complicating gonococcal conjunctivitis, 51
  - resistance of, 17
- Morphine, 53
- Muller's muscle, 10
- Napoleonic expedition to Egypt, eye-disease in, 2
- Necrosis,
  - of cornea, 15
  - of eyelids, 20
  - of follicles, 23, 36
- Night-blindness, 25
- Nystagmus, 14
- Oedema, 7, 20, 46, 49
- Operations,
  - for trachoma, 2, 37, 39
  - for trichiasis and entropion, 1, 40-8
  - for ectropion, 9, 48
  - contra-indicated, 59
  - statistics of, 68
- Ophthalmia,
  - in Egypt, 1, 2
  - in Palestine, 17
  - sympathetic, 53
- Ophthalmia neonatorum,
  - gonococcal, 11, 12
  - non-gonococcal, 28
  - treatment of, 48
  - prophylaxis of, 60
- Pannus,
  - in trachoma, 6, 10, 25-7, 58
  - in conjunctivitis, 17
  - causes defective vision, 11, 26
  - blindness, 62
  - conditions resembling, 55
  - dissection, 35
  - gonococcal inoculation for, 35
  - varieties of, 35
- Panophthalmitis, 14, 52, 63
- Papillae,
  - in trachoma, 8, 23
  - in spring catarrh, 56, 57
  - recurring, 36
- Parinaud's conjunctivitis, 57
- Peritomy, 35
- Perrier water, 51
- Phlyctenular eruptions, 19
- Pneumococcal ophthalmia, 17, 21
- Potassium permanganate solution, 48, 50, 60
- Pre-auricular gland, 14
- Primary Schools, Egyptian, trachoma in, 58, 59, 65, 66
- Prognosis in trachoma, 58
- Prophylaxis, 36, 59

- Protargol, 31, 32, 53  
 Prowazek's "cell inclusions," 28  
 Ptosis, 10, 39
- Races in Egypt, none immune from trachoma, 3  
 Radium treatment, 32  
 Royal London Ophthalmic Hospital, 3
- Saemisch's section, 52  
 Scarification, 34, 51  
 Seraping operations, 33, 34, 35, 57  
 Septicaemia in Egypt, 14  
 Silkworm gut, ophthalmic, 40  
 Silver nitrate solution, 20, 21, 31, 34, 36, 48, 49, 50, 51, 56, 60, 62  
 Silver nitrate stick, 14, 49  
 Snellen's operation, 41, 42  
 Staphylectomy, 53  
 Staphylococcus, 21  
 Staphyloma, 11, 13, 26, 53, 62  
 Stellwag's brawny oedema, 7  
 Strabismus, 14  
 Streptococcus, 21
- Tarsus,  
   in trachoma, 6, 7  
   thickened, 7, 39  
   cicatrizated, 24  
   degeneration of, 27  
   excision of, 37, 39, 47
- Thrush fungus, 21
- Trachoma,  
   origin and nature of, 28  
   acute, 6  
   cause of blindness, 63  
   cicatrization in (Trachoma III and IV), 9  
   clinical stages of, 5  
   complicated by gonococcus (Trachoma IIc), 5, 8, 11-17, 55  
   complicated by other infections, 18-21  
   differential diagnosis of, 55  
   distinct from purulent ophthalmia, 2
- Trachoma,  
   florid, 8, 16  
   follicular, commencing (Trachoma I), 6, 7  
   follicular, advanced (Trachoma IIa), 7, 8. *See* Follicles  
   generalized in Egypt, 3  
   in Egyptian children, 3, 8, 16, 65  
   most infectious stage of, 60  
   neonatorum, 4, 29, 60  
   non-contagious stage of, 60  
   of the cornea. *See* Pannus  
   of the genital passages, 4, 29  
   papillary (Trachoma IIb),  
     unmixed, 5, 8, 24  
     complicated, 8, 23  
   preceded by acute conjunctivitis, 4  
   prognosis of, 58  
   relapses in, 9  
   statistics of, 64-6
- Treatment  
   of trachoma, 30, 66  
   during cicatrizization, 36  
     follicular stage, 31-5  
     papillary stage, 35, 36  
     gonococcal complication, 36  
   of sequelae of trachoma, 40
- Trichiasis,  
   in trachoma, 9, 25, 34  
   known in Ancient Egypt, 1, 2  
   cause of blindness, 62  
   operations for, 1, 40-6, 59  
   statistics of, 68
- Ulceration of cornea. *See* Cornea,  
   ulceration of
- Vaccine treatment, 18, 19, 51  
 Van Millingen's Graft, 44, 45  
 Vision, depreciation of, 11, 26, 67
- Xerosis, 21, 25, 62
- Zinc drops, 33, 54  
 Zinc sulphate, 18, 32



PUBLICATIONS OF THE CAMBRIDGE  
UNIVERSITY PRESS RELATING TO AFRICA

**A History of the Colonization of Africa by Alien Races.** By Sir HARRY H. JOHNSTON, G.C.M.G., K.C.B., Hon. Sc.D. Cantab. New edition, revised throughout and considerably enlarged. Crown 8vo. With 8 maps. 8s net. Cambridge Historical Series.

**Ethnology of A-Kamba and other East African tribes.** By C. W. HOBLEY, C.M.G., A.M.Inst.C.E. Demy 8vo. With 54 illustrations and a map. 7s 6d net.

**The Tribes of Northern and Central Kordofán.** By H. A. MACMICHAEL, Sudan Civil Service, late Scholar of Magdalene College, Cambridge. Demy 8vo. With 19 plates. 10s 6d net.

**Brands used by the Chief Camel-owning Tribes of Kordofán.** By the same author. Demy 8vo. With 17 plates. 6s net.

**Initia Amharica.** An Introduction to spoken Amharic. By C. H. ARMBRUSTER, M.A., Sudan Civil Service. Royal 8vo. Part I. Grammar. 12s net. Part II. English-Amharic Vocabulary with phrases. 15s net.

**Vocabularies of the Kamba and Kikuyu Languages of East Africa.** By HILDEGARDE HINDE (MRS SIDNEY L. HINDE). Crown 8vo. 3s net.

**The Masai Language.** Grammatical Notes, together with a Vocabulary. Compiled by HILDEGARDE HINDE. Crown 8vo. 3s 6d.

**A Grammar of the Somali Language with Examples in Prose and Verse.** And an account of the Yibir and Midgan Dialects. By J. W. C. KIRK, B.A., King's College, Cambridge, Lieutenant, Duke of Cornwall's Light Infantry and 6th (Somaliland) Battalion, King's African Rifles. Demy 8vo. 7s 6d net.

**The Modern Egyptian Dialect of Arabic.** A Grammar, with Exercises, Reading Lessons and Glossaries, from the German of Dr K. VOLLERS. With numerous additions by the Author. Translated by F. C. BURKITT, M.A. Crown 8vo. 10s 6d.

**Dictionary of the Hausa Language.** By the Rev. CHARLES HENRY ROBINSON, D.D., sometime Lecturer in Hausa in the University of Cambridge, Honorary Canon of Ripon. Demy 8vo. Vol. I. Hausa-English. Third edition, revised and enlarged. 12s net. Vol. II. English-Hausa. 9s net.

**Specimens of Hausa Literature.** By the Rev. CHARLES HENRY ROBINSON, D.D. Small 4to. 10s. Translation, Transliteration and Notes, without Facsimiles, 5s.

**A Galla-English, English-Galla Dictionary.** Collected and compiled by E. C. FOOT, F.R.G.S. Published with the aid and approval of H.M. Foreign Office. Demy 8vo. 6s net.

Cambridge University Press  
C. F. CLAY, Manager  
London: Fetter Lane, E.C.  
Edinburgh: 100, Princes Street

CAMBRIDGE UNIVERSITY PRESS  
SELECTED LIST

- The Journal of Hygiene.** Edited by GEORGE H. F. NUTTALL, M.D., F.R.S., JOHN S. HALDANE, M.D., F.R.S., ARTHUR NEWSHOLME, M.D., F.R.C.P., CHARLES J. MARTIN, M.B., F.R.S. Quarterly. Royal 8vo. The subscription price, payable in advance, is 21s net per volume (post-free); single numbers 7s net.
- Parasitology.** Edited by GEORGE H. F. NUTTALL, F.R.S., and A. E. SHIPLEY, F.R.S. Parasitology is published about four times a year. A volume containing about 400 to 500 pages, with plates and figures, is issued annually. The subscription price is £1 10s per volume (post-free), payable in advance; single numbers 10s net.
- Biometrika.** A Journal for the Statistical Study of Biological Problems. Founded by W. F. R. WELDON, FRANCIS GALTON and KARL PEARSON. Edited, in collaboration with C. B. DAVENPORT, W. PALIN ELDERTON, W. R. MACDONELL, RAYMOND PEARL, by KARL PEARSON. Quarterly. Subscription price, payable in advance, 30s per volume (post-free). Single numbers 10s net.
- The Journal of Pharmacology and Experimental Therapeutics.** Edited by Professor JOHN J. ABEL, The Johns Hopkins University, and Professor A. R. CUSHNY, University of London. Issued bi-monthly. Annual subscription 21s net.
- The State Provision of Sanatoriums.** By S. V. PEARSON, M.D., M.R.C.P. Demy 8vo. 3s net.
- Observations upon the Natural History of Epidemic Diarrhoea.** By O. H. PETERS, M.D., D.P.H. Large Royal 8vo. With 38 tables and 9 charts. 7s net.
- Mendel's Principles of Heredity.** By W. BATESON, M.A., F.R.S., V.M.H., Director of the John Innes Horticultural Institution. Third impression with additions. Royal 8vo. With 3 portraits, 6 coloured plates and 38 figures. 12s net.
- Immunity in Infective Diseases.** By ÉLIE METCHNIKOFF, Foreign Member of the Royal Society of London, Professor at the Pasteur Institute, Paris. Translated by FRANCIS G. BINNIE, of the Pathological Department, University of Cambridge. With 45 figures. Royal 8vo. 18s net.
- A Treatise on Plague dealing with the Historical, Epidemiological, Clinical, Therapeutic and Preventive Aspects of the Disease.** By W. J. SIMPSON, M.D. Aberd., F.R.C.P. Lond., D.P.H. Camb., Professor of Hygiene, King's College, London, etc., etc. Royal 8vo. With maps and illustrations. 16s net.
- Manual of Practical Morbid Anatomy, being a Handbook for the Post-mortem Room.** By H. D. ROLLESTON, M.A., M.D., F.R.C.P. and A. A. KANTHACK, M.D., M.R.C.P. Crown 8vo. 6s.
- The Vertebrate Skeleton.** By S. H. REYNOLDS, M.A., Professor of Geology in the University of Bristol. Second edition. Demy 8vo. 15s net.
- Thomas Linacre.** By WILLIAM OSLER, M.D., F.R.S., Linacre Lecture, 1908, delivered at St John's College, Cambridge. Crown 8vo. With 11 plates. 2s 6d net.

Cambridge University Press  
C. F. CLAY, Manager  
London: Fetter Lane, E.C.  
Edinburgh: 100, Princes Street  
1913









